June, 2010

California Interregional Blueprint Phase I Narrative Assessment

"We must recognize that we are on the cusp of a new wave of transportation policy. The infrastructure challenge of President Eisenhower's 1950s was to build out our nation and connect within. In the 1980s and 1990s it was to modernize the program and better connect roads, transit, rail, air, and other modes. Today, the challenge is to take transportation out if its box in order to ensure the health, vitality, and sustainability of our metropolitan areas."

~Brookings Institute~
A Bridge to Somewhere

Caltrans

Funding for this study was provided by the California Department of Transportation through the Federal State Planning and Research Program.

Disclaimer

The statements and conclusions in this report are those of the authors and are not necessarily those of the California Department of Transportation (Caltrans).

Prepared by:

Lauren Michele [Hilliard] (author), Mary Madison (editor) and Mike McCoy (principal investigator) Urban Land Use and Transportation Center, University of California, One Shields Avenue, Davis, CA 95616, under contract to the California Department of Transportation, Division of Transportation Planning.

June 2010

Acknowledgments: We appreciate the thoughtful review and suggestions from the Caltrans Office of State Planning, including: Pam Korte, Contract Manager, Del Deletetsky, Stuart Mori, and Laurie Waters. A very special thank you to the California Interregional Blueprint Team members for all of their time and valuable input throughout the development of this concept paper

TABLE OF CONTENTS

CALIFORNIA INTERREGIONAL BLUEPRINT: PURPOSE AND PROCESS

The California Interregional Blueprint (CIB) will synthesize planned interregional highway, transit, rail (including high-speed and intercity rail), goods movement, and other state transportation projects and strategies with regional transportation and land use plans. By combining this information into a unified view, for the first time California planners can link regional data at a statewide level to jointly plan for the future of an integrated transportation and land use network.

This linkage and understanding is imperative, because regional actions impact interregional travel and, conversely, state actions impact regional travel. An accurate understanding of regional plans will provide the basis for improved analysis and public engagement about interregional and statewide investments and policies. With better data and informed discussions, Californians can intelligently link land use and transportation, leading to a reduction in greenhouse gas (GHG) emissions, strategic multi-modal planning, and connected regional and state transportation plans that support mutual planning goals as well as legislative mandates.

The CIB will be completed in two phases. Phase I includes the preparation of this narrative with supporting maps that combine the latest available data from state and regional plans on interregional corridors for state highways, intercity and high-speed passenger rail, transit, goods movement and public use airports. Appendix A provides statewide maps that reflect this data collection effort. The result is a *qualitative* analysis, in advance of emerging modeling tools now under development, of the Regional Transportation Plans (RTPs) from the four largest Metropolitan Planning Organizations (MPOs) and the eight MPOs in the San Joaquin Valley. The analysis considers how Blueprint-based planning strategies – such as policies to prioritize management of the existing transportation system and reduce total vehicle-miles-travelled (VMT) – can be evaluated for effectiveness using metrics that are consistent with the California Department of Transportation's (Caltrans) Smart Mobility Framework. Due to data availability and limitations, the remaining MPOs and rural Regional Transportation Planning Agencies were not included in the Phase I analysis; however, Phase II will comprehensively evaluate policy outcomes for all of California's eighteen MPOs and will include rural RTPAs as data becomes available.

Phase I provides a snapshot of the current interregional transportation system and some early insights regarding the effects of scenario-based regional planning on statewide goals such as GHG reduction. It includes a recommended "Action Plan" based upon Caltrans' continuing efforts to guide future transportation investments with performance criteria such as cost-effectiveness, greenhouse gas reduction, and improved safety. The analysis performed in the first phase of the CIB lays the foundation for recommendations that: 1) build on existing efforts by Caltrans and MPOs to implement sustainable transportation and land use plans in California and 2) can be considered in the next update to the California Transportation Plan (CTP) for 2040. A progress report on Phase I activities including key observations from this narrative will be submitted to the California Business, Transportation and Housing Agency in September, 2010.

Phase I provides a vision for the CIB, collects and analyzes baseline data, and includes a workplan for continued implementation, while Phase II (if funded, as recommended in Phase I) will provide the necessary tools to *measure* how successful collective plans for the transportation system will be in achieving statewide goals. Phase I gathers together raw, sometimes incompatible data sets for initial review. Improved information will be needed to support modeling tools that will be operational in December, 2012. Among these tools, the Statewide Integrated Interregional Transportation, Land Use

and Economic Model (SIIM) will allow continued and improved assessments of GHGs, multi-modal travel needs, and land use strategies so that improvements in any region of the state can be translated to improvements throughout the connecting corridors. The SIIM will also provide the ability to analyze alternative scenarios for addressing transportation demand in order to improve these outcomes. Finally, land use and transportation planning efforts will have integrated tools to support cohesive practices that are founded on and aligned with regional priorities.

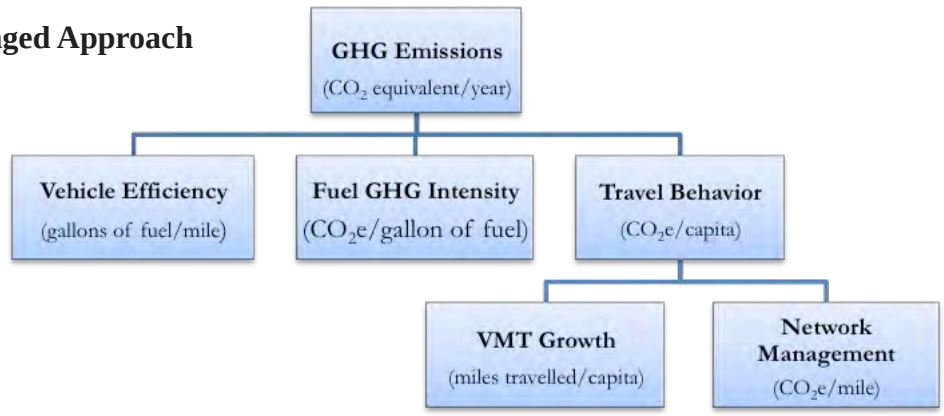
The CIB, both Phase I and Phase II, informs Caltrans' implementation of a transportation framework that will achieve the California Transportation Plan's "3 E" objectives for a sustainable statewide transportation system based on a: prosperous economy, quality environment, and social equity. Linking regional information at a statewide level, the CIB serves as a platform to support interagency collaboration to jointly plan for a future integrated California transportation and land use network.

POLICY CONTEXT

In California, the transportation sector accounts for approximately 38 percent of the total GHG inventory, with 65 percent of emissions coming from light duty trucks/cars and on-road freight.*(1)* In 2005, Executive Order S-3-05 established a goal of reducing GHG emissions by 80 percent below 1990 levels by 2050. The following year, the California legislature passed the *Global Warming Solutions Act*, Assembly Bill 32 (AB 32), calling for a reduction in GHG emissions to 1990 levels by 2020. In the AB 32 Climate Change Scoping Plan, the California Air Resources Board (ARB) recommends a three-pronged approach for reducing GHG emissions from personal vehicles. This three-pronged approach identifies vehicle technology, fuel GHG intensity, and travel behavior as key components contributing to overall passenger vehicle GHG emissions (see Figure 1). Further, the California Energy Commission's *2007 Integrated Energy Policy Report* states that to reduce GHG emissions, California must begin reversing the current two percent annual growth rate of vehicle miles traveled.*(2)*

Since the release of the ARB's Scoping Plan in December 2008, other agencies have introduced improved network management as a way to reduce GHG from personal vehicles. The United States Department of Transportation (DOT) highlights the importance of "system efficiency" in addition to vehicles, fuels, and travel activity.*(3)* The co-benefits of an efficient system stretch beyond GHG reduction. Linking jobs and housing reduces commute costs and stress for employees, while more compact development creates opportunities for protected open space that supports natural resources and the people who enjoy interacting with them. The CIB addresses the roles that reducing VMT growth and improving network management (i.e., system efficiency) have in meeting GHG reduction goals while also promoting a prosperous economy, quality environment, and social equity.

FIGURE 1. Three-Pronged Approach to GHG Reduction



Laws and Regulations

In recent years, California has passed several key laws and regulations regarding transportation and land use planning; environmental review process; and funding structures:

- ***Assembly Bill 1493*** – (2002) AB 1493, commonly referred to as the Pavley regulations, required a 30 percent reduction in GHG emissions by 2016 and became the first vehicle GHG legislation in the United States.

- ***Assembly Bill 857*** – (2002) AB 857 establishes state priorities promoting equity, a strong economy, environmental protection, health and safety in urban, suburban and rural communities. It requires all state agencies to specify how infrastructure expenditures are consistent with infill development and redevelopment, cultural and historic resources, environmental and agricultural resources, and efficient development patterns.

- ***Assembly Bill 2140*** – (2000) AB 2140 established authority for MPOs to create scenario-based regional growth visions. This served as the basis of the California Regional Blueprint Planning Program.

- ***Executive Order S-3-05*** – (2005) California Governor Arnold Schwarzenegger issued this Executive Order to establish a goal of reducing greenhouse gases by 80 percent below 1990 levels by 2050.

- ***Assembly Bill 32*** – *Global Warming Solutions Act*: (2006) AB 32 called for a reduction in GHG emissions to 1990 levels by 2020. Under AB 32, the State established a Climate Action Team (CAT) to guide the development of the *Climate Change Scoping Plan.* The CAT included subgroups such as the Land Use Subgroup of the Climate Action Team (LUSCAT). The California Air Resources Board is responsible for overseeing the implementation of AB 32.

- ***"Low Carbon Fuel Standard***" – (2007) This regulation requires oil companies to reduce the life-cycle GHG emissions from transportation fuels 10 percent by 2020.

- ***Senate Bill 97*** – *California Environmental Quality Act (CEQA) Guidelines:* (2007) The Governor's Office of Planning and Research (OPR) and the Natural Resources Agency were tasked with updating the CEQA Guidelines to provide assistance to public agencies regarding the analysis and mitigation of the effects of GHG emissions in CEQA documents.

- ***Senate Bill 375*** – (2008) SB 375 requires GHG targets to be set and Sustainable Communities Strategies to be developed through Metropolitan Planning Organizations' Regional Transportation Plans under an integrated land use and transportation planning framework.

- ***Senate Bill 732*** – *Strategic Growth Council:* (2008) SB 732 created the Strategic Growth Council to assist state and local entities in the planning of sustainable communities and meeting AB 32 climate change goals. The Council includes representatives from the Governor's Office of Planning and Research; Natural Resources Agency; California Environmental Protection Agency; California Business, Transportation and Housing Agency; and the California Health and Human Services Agency.

- ***Assembly Bill 842*** – (2008) AB 842 requires the Department of Housing and Community Development, when ranking applications for funding under the Infill Incentive Grant Program

and the Transit Oriented Development Implementation Program, to award preference or priority to projects located in areas where the local or regional entity has adopted a general plan, transportation plan, or regional blueprint that will reduce the *growth* of VMT by at least 10 percent. Proposed projects must also be consistent with the relevant VMT-reducing plan.

- ***Senate Bill 391*** – (2009) SB 391 requires Caltrans to update the California Transportation Plan (CTP) to address how the State will achieve "maximum feasible emissions reductions" consistent with AB 32 and Executive Order S-3-05 and to identify the statewide integrated multimodal transportation system that will achieve these results. The first update of the CTP must be completed by December 31, 2015 with updates every five years thereafter.

From Policy to Action

Since the passage of AB 32, SB 375 and SB 391, the following agencies and commissions have increased actions within their existing legislative and regulatory authority:

California Department of Transportation (Caltrans)

- *California Regional Blueprint Planning Program*: This is Caltrans' voluntary, discretionary, grant program for regional integrated land use and transportation planning. It is based on Government Code Sections 65041.1, 65080, and 65584, which established authority for MPOs to create scenario-based regional growth visions.
- *California Interregional Blueprint*: The CIB combines the latest available data on interregional corridors for state highways, transit (including rail) and goods movement, with a policy vision that seeks to respond to the integrated land use and transportation plans of the major MPOs in California. It marks the beginning of a new type of inter-agency collaboration that will jointly plan for the future of California's integrated transportation and land use network.
- *Smart Mobility 2010*: A planning framework, produced collaboratively by Caltrans and the US Environmental Protection Agency, of tools and performance-based metrics to help guide and assess how well plans, programs, and projects meet "smart mobility" objectives, such as improved transportation choices and reduced GHG. The framework is designed for use by Caltrans and partner agencies in all areas of the state (i.e., urban, suburban, and rural areas).
- *Complete Streets Guidelines*: Caltrans implemented a revised Deputy Directive 64 in October 2008 stating that "the Department views all transportation improvements as opportunities to improve safety, access, and mobility for all travelers in California and recognizes bicycle, pedestrian, and transit modes as integral elements of the transportation system."
- *Context Sensitive Solutions:* Caltrans is encouraging staff to embrace this inclusive approach to planning, designing, constructing, maintaining, and operating our transportation system. It attempts to balance transportation goals with community goals and natural environments by integrating transportation safety and performance goals with other values in a collaborative process.
- *Corridor System Management Planning:* A planning process used by Caltrans, MPOs, RTPAs, cities and counties to manage and operate mainly urban freeway corridors for highest productivity.
- *Statewide Integrated Interregional Transportation, Land Use, and Economic Model*: This model

will project the impact of statewide policies and investments on regions throughout California and the interaction of regional policy choices and investments with statewide efforts. California's four largest MPOs are developing corresponding models needed to support SB 375 and SB 391 implementation.

- *Statewide Household Travel Survey*: Conducted in collaboration with MPOs, this survey will update statewide database of household socio-economic and travel behavior information, and is an essential step for the development of the statewide and regional integrated models.

California Governor's Office of Planning and Research / Strategic Growth Council

- *Vision California*: In conjunction with the California High Speed Rail Authority, this project is producing new scenario development and sketch planning tools and a series of alternative physical visions for how California can accommodate expected growth.
- *General Plan Guidance*: The Governor's Office of Planning and Research is in the process of updating the 2003 General Plan Guidelines to provide guidance to cities and counties in the preparation of local general plans -- the next edition will reflect legislative requirements enacted since 2003 (AB 32, SB 375, SB 97) and new guidance on addressing climate change and complete streets.
- *Proposition 84 Grants:* The Strategic Growth Council is allocating $180 million one-time grants and loans to regional and local governments, with $12 million going to California's major MPOs for model development and $60 million for community planning grants.

State of California Air Resources Board (ARB)

- *SB 375 Implementation*: ARB is responsible for establishing 2020 and 2035 automobile/light truck sector GHG targets for California's 18 MPOs – including strategies to reduce VMT and improve network management through incentive programs and regulations. ARB is also responsible for approving an MPO's "Sustainable Communities Strategy" or "Alternative Planning Strategy."

State of California Transportation Commission (CTC)

- *Regional Transportation Plan Guidelines:* CTC adopted updates to the RTP Guidelines in April 2010 pursuant to the requirement in SB 375 to make the existing policy, action, and financial elements (along with the newly created "Sustainable Community Strategy" element) within RTPs internally consistent.

State of California Energy Commission (CEC)

- *Data Collection:* Under AB 32, ARB used statewide fuel sales data from Board of Equalization and federal fuel use data to establish a 1990 GHG inventory to determine their economy-wide GHG 2020 target. Opportunities for added data include the use of existing odometer data from the Bureau of Automotive Repair and Department of Motor Vehicles aggregated to zip code level for use by ARB and local and regional governments who lack the funding for developing GHG inventories.

- *Local Government Assistance Programs:* CEC allocates over $100 million in research and program grants to reduce energy consumption. The agency is also overseeing a large share of federal stimulus funding.

FUNDING CONTEXT – A MOVING TARGET

As important as the policy context is, funding levels, sources, and criteria ultimately drive transportation decisions. While regional entities fund the majority of projects on California's roadways, Caltrans Districts and local governments work closely with MPOs on project selections. A Regional Transportation Improvement Program (RTIP) is the short-range program of transportation improvements based on the long-range RTP, and is updated every four years in coordination with the cities and counties in the region. Regardless of city or county designated transportation projects, local improvements must be included in the regional RTP to receive state and federal funding. As a result, traditional RTPs and RTIPs have largely been comprised by combining the individual transportation plans of its member cities, counties, and various transit districts.

The State of California provides some revenue for transportation projects to regional transportation planning agencies (RTPAs) to fund capital projects that are on and off the state highway system and are listed in the State Transportation Improvement Program (STIP). Seventy-five percent of federal and state funds for capital outlay go to RTPAs, with the remaining twenty-five percent allocated to Caltrans. This disbursement is the result of a 1997 law (SB 45) that shifted 75 percent of transportation revenues directly to RTPAs. To better target its resources, Caltrans has designated ten highway "focus routes" as priority corridors, along with supporting Amtrak services on selected intercity rail routes, for its investments.

The State's Legislative Analyst's Office states that "funding for the state's transportation programs is not predictable from year to year. This creates difficulties in the state's ability to plan and deliver capital improvements."*(4)* The 2002 passage of Proposition 42 constitutionally required the State's share (5%) of the sales tax on gasoline to be used for transportation, but allowed the Legislature and Governor to suspend during a fiscal crisis. Proposition 42 revenues allocate 40 percent to local roads, 40 percent to the STIP, and 20 percent to the Public Transportation Account.*(5)* Caltrans estimates that the state gas tax currently generates about $3.2 billion per year, Proposition 42 state sales tax generates about $1.4 billion per year, and truck weight fees generate about $1 billion per year for transportation projects.

State Transportation Development Act funds (1/4% of general sales tax) and federal transit funding have been the primary funding sources for operations and major bus and transit capital projects over the past two decades. The decline in gas tax revenue and available funding in the Highway Trust Fund and Mass Transit Account has put a greater strain on states and local governments to generate revenue streams of their own in the context of balancing their budgets. In addition to declining funding, allocations of federal dollars may be changing. On January 13, 2010 Secretary LaHood of the US Department of Transportation declared a major change to transit funding criteria that would consider "all factors that help communities reduce their carbon footprint, relieve congestion, and spur economic activity….(and) align priorities and values with investments in transit projects that strengthen communities."*(6)*

The largest single planned investment in transit, including committed and proposed funds, is California's high-speed passenger rail system – totaling $19 billion in federal funds, $9 billion in state funds, $4 billion in local funds, and $10 billion in private funds.*(7)* Capitalizing on this large infrastructure investment will require strategic expenditures on transportation and land use projects to support the statewide rail system, and advanced modeling capabilities to understand how to optimize California's transportation network.

There are some recent infusions of short-term funding as well. The American Recovery and

Reinvestment Act (ARRA) of 2009 allocated $2.57 billion to California for highways, local streets and roads, freight and passenger rail, and port infrastructure projects, and $1.07 billion for transit projects – with $1.6 billion going directly to regional transportation planning agencies and MPOs, and $77 million going to transportation enhancement projects such as bicycle and pedestrian infrastructure.*(8)* Further, California received $2.25 billion in ARRA funding for the implementation of the statewide high-speed rail network.

Overall, state and federal funding accounts for less than half of all funding for RTPs. Funding from voter-approved local sales tax measures (up to 1 percent additional local sales tax) in 21 counties now provides nearly $4 billion in transportation funding annually. Table 2 shows that federal and state transportation revenues provide roughly 30-45 percent of the funding source needed for California's major MPOs to implement their "financially/revenue constrained" RTPs. Federal law requires metropolitan transportation plans to be financially constrained, limiting what the plan can propose to revenues reasonably expected to be available. This provides planners with a realistic view regarding what projects or programs in an RTP will come to fruition. In addition, MPOs planning transportation projects in areas that have not met their air quality standards cannot receive federal funding or approval unless the MPO can show that the projects are consistent with state air quality goals.*(9)*

TABLE 1. Percentage of Revenue Sources for Regional Transportation Plans

	SACOG	MTC	SANDAG	SCAG
Base Year	2006	2004	2006	2003
Horizon Year	2035	2030	2035	2035
RTP Budget	$41.7 billion	$218 billion	$58 billion	$186.7 billion
Federal Revenue	16%	13%	19%	10%
State Revenue	22%	21%	28%	20%
Regional /Local Revenue	62%	60%	53%	70%

CIB SETS STAGE FOR NEW TRANSPORTATION ERA

The CIB marks the beginning of a collaborative platform from which state agencies, regional governments, transit operators, the goods movement industry, local jurisdictions, and varied stakeholder groups can update transportation policies and plans to meet new converging objectives. The updates will necessarily reflect recently-adopted policy initiatives and their goals such as climate change, sustainable communities, multi-modal transit options and VMT reduction. The CIB will support these existing objectives through the improved analysis and understanding of regional transportation and its effect on interregional planning and statewide strategies.

The CIB will help to implement performance measures to determine GHG and VMT reductions as defined in the Smart Mobility Framework, and as mandated by recent legislation. The CIB can be a resource in determining interregional transportation funding priorities to optimize cost-effectiveness and GHG reduction; in focusing data collection and analysis; in providing resources to measure performance of the integrated system; and in updates to Caltrans guidance documents. Through the shared information and analysis that the CIB fosters in Phases I and II, California can create and translate policies into meaningful changes that meets the California Transportation Plan's "3 E" objectives of fostering a prosperous economy, a quality environment, and social equity. The following highlights

recent research and studies that demonstrate how coordinated transportation and land use strategies can support the CTP's "3E" objectives.

Economy: Economic Benefits are Tied to Better Planning Strategies

The challenge in improving transportation network management and reducing VMT growth lies in finding strategies that help support (rather than disrupt) California's economy. This means supporting mobility and access, and recognizing that vehicle and person trips are a subset of the larger mobility framework. Reducing vehicle trips, not necessarily person trips, allow our existing highway and transit systems to operate more cost-effectively. Additionally, a planned investment of approximately $43 billion in a statewide high-speed passenger rail system *(7)* will dramatically change local and regional economies across California, and is a primary motivation for the need to capitalize on existing state and federal investments through mobility and land use changes that will support its success.

The Victoria Transport Policy Institute released a study on January 8, 2010 that finds in industrialized countries, per capita gross domestic product tends to increase with lower per capita VMT, as well as higher fuel prices, higher per capita public transit ridership, higher land use density, and lower per capita lane-miles.*(10)* Further, the analysis indicates that policy and planning reforms which improve transportation options, efficiently price vehicle travel, and create more accessible, multi-modal, smart growth communities tend to increase economic productivity in addition to their social and environmental benefits.*(10)*

Analysis from the Center for Clean Air Policy indicates that "greenhouse gas reductions can be achieved with significant net positive economic benefits when factoring in avoided infrastructure costs, consumer fuel and insurance cost savings and projected tax revenue growth from high value economic development."*(11)* GHG reduction measures from travel behavior are an integral part in shifting funding priorities toward a market which supports compact, transit-oriented-developments that in turn revitalize urban cores and district centers. This in turn decreases the need for investments in additional capital and maintenance costs created from new highway capacity projects. Additionally, strategies that support economic vitality in urban areas, such as balancing jobs and housing in regions, also have impacts on the economic health of rural communities.

Equity: Funding Sustainable Transportation Systems and Connecting Communities Yields Co-Benefits

In a state where minority populations are becoming the political majority, considering ways to create linked, diverse communities can help support growing, successful economies. According to Dr. Manuel Pastor, Director for the Program for Environmental and Regional Equity at the University of Southern California, who cited not only his own studies, but those of the Cleveland Federal Reserve, reductions in poverty, inequality and segregation support improved economies.(*12*) Considering ways to support California's ethnically diverse population through better access to transit and stronger linkages between land use and transportation will become fundamental as planners consider what "sustainability" truly means.

Network management aimed at reaching legislative goals of GHG reduction has associated "co-benefits" such as improved safety, cost-effectiveness, open space preservation, and improved access to goods and services. For example, the provision of affordable housing near transit service is an important strategy for both GHG reduction and creating access to jobs for community residents. Increased access

to and support of multi-modal options such as bicycling and walking lower VMT while increasing healthier choices for community residents. More open space through better planning creates increased opportunities for safe, outdoor physical activity. Strategies that reduce GHG emissions can also increase public safety. Reid Ewing and Eric Dumbaugh report that the traffic environments of dense urban areas are safer than lower-volume environments in the suburbs due to lower vehicle speeds and more "pedestrian-oriented" street designs.*(13)* Further, the authors find that 85 percent of vehicle/pedestrian collisions result in a pedestrian fatality when vehicles are travelling 40 mph, and this falls to 45 percent at 30 mph, and 5 percent at 20 mph.*(13)*

Environment: Combining Land Use and Transportation Strategies Can Yield GHG Reductions and Other Resource Benefits

Managing the existing transportation network plays a critical role in helping California reduce transport-related GHG emissions. GHG reduction measures from travel behavior can be categorized into four major categories:

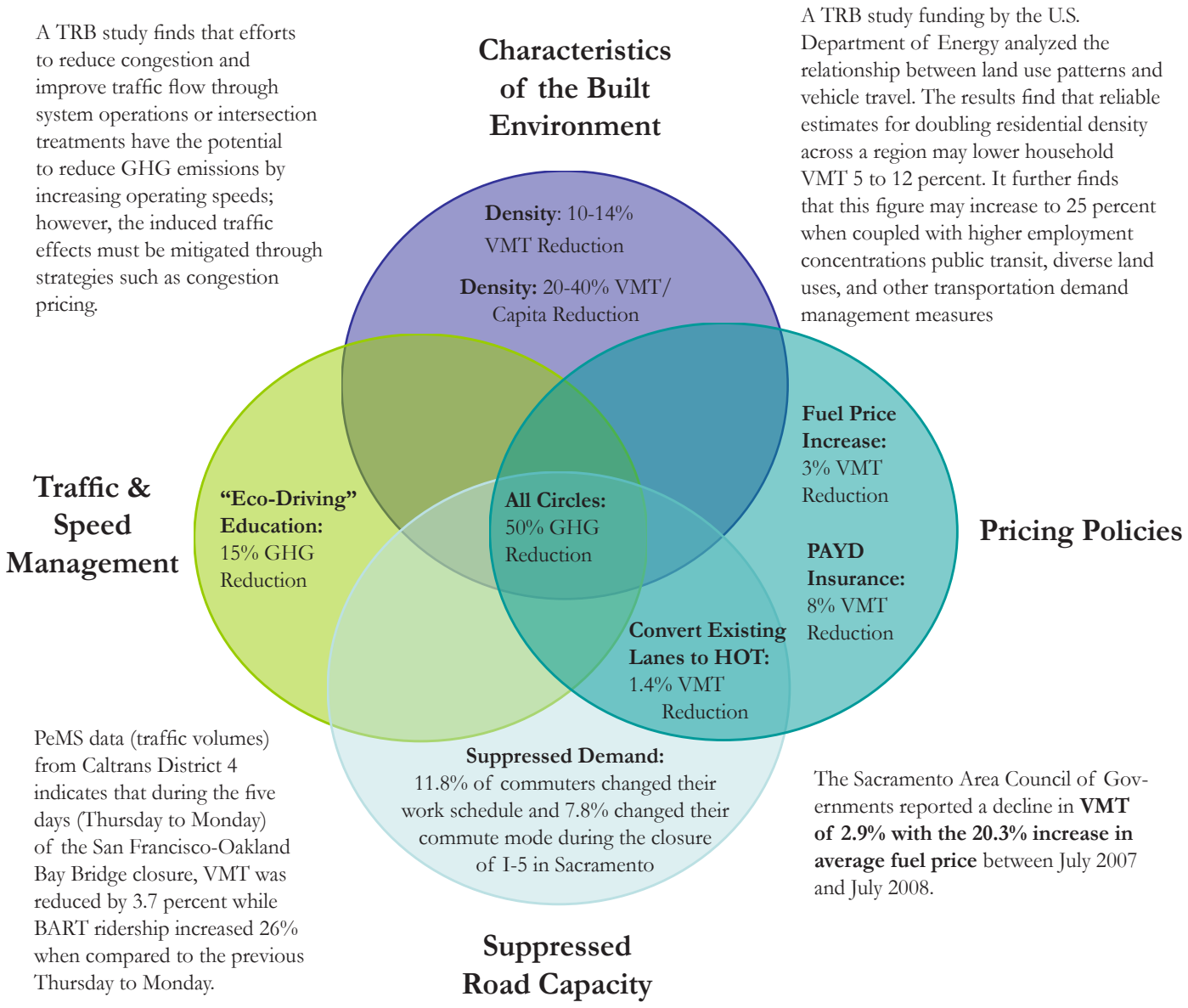
1) C*haracteristics of the Built Environment* (VMT reduction);
2) *Pricing Policies* (VMT reduction);
3) *Suppressed Roadway Capacity* (VMT reduction); and
4) *Traffic and Speed Management* (network management)

As illustrated in the overlapping of the strategies represented by the four circles in the center of Figure 2, strategies that address travel behavior are inter-related and greater reductions occur when they are co-implemented. Current research on using travel behavior strategies to reduce GHG emissions indicate that combining measures has a much higher effect on emissions reduction than implementing single policy strategies. For example, if infill development (Characteristics of the Built Environment) is implemented without an incremental price signal (Pricing Policies) then the GHG emissions reductions would be less than with pricing policies because there would be less incentive toward shorter trips.

The following are key findings from a selection of current research and studies that support the concepts described in the "Four Circles" approach illustrated in Figure 2.

Growing Cooler: The Evidence on Urban Development and Climate Change (*Growing Cooler*) provides an analysis of the combined effect of compact development and transportation strategies based on elasticities from the Texas Transportation Institute. The data includes a "Low Carbon Scenario" for 2030 which finds that slowing highway capacity growth by a third while doubling transit capacity, development density, and fuel prices yields a 38 percent combined reduction in VMT from the trend scenario.*(14)* In Ewing's *CO2 Reductions Attributable to Smart Growth in California,* the GHG reductions for 2020 from compact development alone range from 3.4 to 4.7 percent.(*15*) *Growing Cooler* estimates that by making reasonable assumptions about growth rates, market share of compact development, and the relationship between VMT and carbon dioxide, compact development could reduce total transportation-related GHG emissions from current trends by seven to ten percent in 2050 and US VMT by ten to fourteen percent.*(14)* In *Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions*, the analysis finds that under maximum deployment of the "long-term/maximum results bundle," which combines most of the 50 measures evaluated, GHG emissions can drop 24 percent without strong economy-wide pricing measures.(16*)* With a nationwide price signal, such as fuel taxes equivalent to those in Europe, a 52 percent reduction would be possible. *(16)*

FIGURE 2. Four Circle Approach to GHG Reduction from Travel Behavior (see Appendix B for citations)



Based on empirical research and modeling estimates (for detailed analysis see Appendix B, Tables 1 & 2), it is feasible for significant reductions in VMT and GHG emissions to result from strategies such as compact development, increased access to goods and services, pricing policies, reduced growth in roadway capacity, and transportation system efficiency through speed and traffic management measures. This effect is compounded when strategies are combined. Despite the large range in baseline trend assumptions for GHG reduction ranges from land use strategies, it is still evident that if policy trends and new markets emerge toward smart growth planning practices, we can expect approximately ten percent GHG emissions reduction from this new form of development alone. Communities should be empowered to combine strategies from each of the Four Circles illustrated in Figure 2 in order to suit their particular needs. Appendix B, Table 3 includes a detailed literature review regarding the dynamics between such variables and what ranges in GHG reduction are reasonable based on varying assumptions for future growth trends.

PHASE I: THE CIB NARRATIVE

Regional transportation agencies play an important role in the development of California's roadway system. Because any statewide strategies to reduce the growth of VMT and GHG emissions inherently rely on regional efforts, Phase I of the CIB includes a review of a strategic selection of RTPs and assesses how local scenario-based planning can help meet statewide goals of GHG and VMT reduction. This report analyzes RTPs from the four largest Metropolitan Planning Organizations and the eight MPOs in the San Joaquin Valley to consider the effect of Blueprint-based planning strategies using performance metrics that are consistent with some of the 17 performance metrics identified in the Smart Mobility Framework. These metrics are:

- Support for Sustainable Growth
- Emissions Reduction
- Multi-Modal Travel-Time Mobility
- Climate and Energy Conservation

Regional Blueprints Create a New Vision

Initiated in 2005, the Regional Blueprint Planning Program supports collaborative planning processes that engage residents of a region in articulating a vision for their long-term future. The regional vision is developed from residents' values and priorities, and informed by advanced geographic information system (GIS) modeling and visualization tools that demonstrate the impacts of growth and planning decisions. The process leads to the development of alternative growth scenarios for the region, and through a public process a preferred growth scenario is selected that can then guide regional and local land use and transportation decisions for a future that is sustainable, while meeting residents' needs and providing a high quality of life for all.

Since its inception, a total of eighteen MPOs and fifteen RTPAs have participated in this state-funded program to consider alternative growth scenarios and develop public outreach to evaluate planning choices and their respective outcomes. Because Regional Blueprints are relatively new, and because the preferred scenario choices provide voluntary, not mandatory, gudance for regional and local planning, their implementation is in the beginning stages. While there is limited information about how influential Blueprint scenarios have been in the development of RTPs and local project implementation, this initial data can provide:

- Regional Blueprint preferred growth scenario maps layered with current statewide multi-modal transportation data. Appendix A contains maps showing Blueprint-designated planning scenarios, and how Caltrans' planned interregional mobility corridors for state highways, goods movement, and intercity and high-speed passenger rail interface with Blueprint planning trends.
- Initial evaluations of how RTPs developed under a Blueprint integrated land use and transportation planning framework can support statewide strategies such as GHG and VMT reduction. This report highlights the case of the Sacramento Area Council of Governments (SACOG) Regional Blueprint, because SACOG is one of the first regional agencies to base its RTP on the preferred growth scenario contained in its Blueprint.

By evaluating current and future regional transportation plans through a lens of Blueprint-designated priorities, Caltrans and regional planning partners can better identify current and future GHG emissions

from transportation and support the California Transportation Plan's vision of an integrated, statewide multimodal transportation system. By considering regional priorities, plans, and data in a statewide context, policymakers can better target funds and projects so they connect and enhance existing state and regional goals and strategies.

Evaluating RTPs and their Relationship to Regional Blueprints

A *qualitative* analysis (in advance of emerging modeling tools now under development) of the RTPs and regional blueprints from the four largest MPOs and the eight MPOs in the San Joaquin Valley was conducted as part of this effort. The objective was to consider how Blueprint-based planning strategies – such as policies to prioritize management of the existing transportation system and reduce total VMT – can be evaluated for effectiveness using metrics that are consistent with the Caltrans Smart Mobility Framework. A summary analysis of each of the RTPs and Blueprints is included below. Due to data availability and limitations, the remaining MPOs and rural RTPAs were not included in the Phase I analysis; however, Phase II of the CIB will comprehensively evaluate policy outcomes for all of California's eighteen MPOs and will include rural RTPAs as data becomes available.

ABAG / MTC RTP 2035

The Association of Bay Area Governments (ABAG is the land use Council of Governments for the nine-county San Francisco Bay Area) and the Metropolitan Transportation Commission (MTC is the region's transportation MPO) developed the FOCUS Growth Vision in 2008, built on the 2020 Smart Growth Strategy developed in 2002. MTC's 2035 RTP contains land use assumptions that are broadly consistent with existing General Plans, but also assumes a more smart growth-based projection. The region has set forth the largest investment of any MPO in their 2035 RTP. Of the $218 billion RTP budget, planned expenditures for critical interregional highway routes total $3.307 billion – with $2.525 billion in committed funds. These funds will be used for the Bay Area's development of an express lane network (High-Occupancy-Toll lanes), and other capacity and network management investments. Additionally, ABAG/MTC is investing nearly twice as much in planned expenditures for Caltrans' planned or programmed interregional rail corridors (e.g., Capitol Corridor; rail/bus feeder systems into statewide high-speed rail) – with $8.533 billion in programmed/committed funds for transit. The RTP 2035 includes performance measures with strong targets supporting the "3 Es," including travel delay per capita (economy), reduction of VMT per capita by ten percent (environment), and decreased household expenditure on housing by ten percent (equity). The region's RTP finds that land use and pricing mechanisms are needed to achieve the plan's performance targets, and that infrastructure investment alone could not meet regional needs for the economy, environment, and equity.

SCAG RTP 2035

The Southern California Association of Governments (SCAG) developed the 2030 Compass Blueprint in 2004, which spawned the 2035 Regional Comprehensive Plan in 2008. SCAG also developed an Integrated Growth Forecast in 2008 that replaced the Regional Growth Vision's forecasts for population, jobs, and housing in the region – including a Baseline and Vision scenario. While the Vision scenario uses Compass blueprint land use projections, the 2035 RTP uses the Baseline growth forecasts that include "business-as-usual" development trends. However, SCAG is actively collaborating with local governments to develop policies and strategies based on the Compass Blueprint principles, and has included many of these principles as policies in their 2035 RTP. The region has a $186.7 billion RTP budget – with $2.498 billion planned (not committed) for critical interregional highway routes, $3.924 billion planned (not committed) for interregional rail corridors, and $36.4 billion for Caltrans' planned or programmed goods movement system (investments overlap with highways). The 2035 RTP includes

performance measures that also support the Caltrans' "3 Es," including a reliable, productive, and cost-effective transportation system (economy); sustainability and emissions reduction (environment); and environmental justice, accessibility, and safety (equity). The Compass Blueprint contains stronger targets for VMT reduction, transit use, and GHG reduction; however, these specific metrics are not included in the RTP. The region's RTP focuses on maintaining already existing infrastructure and infill, while increasing the number of HOV lanes/capabilities and implementing region-wide network management strategies through congestion pricing and tolling.

SANDAG RTP 2030

The San Diego Association of Governments (SANDAG) adopted a Smart Growth Concept Map in 2008 based on the region's 2030 Regional Comprehensive Plan established in 2004. SANDAG's 2030 RTP contains land use assumptions that are based on existing jurisdictions' General Plans, which make up 40 percent of the "existing or planned" Smart Growth Concept Map growth areas. The 2030 RTP budgets $58 billion for regional transportation, with $0.595 billion in planned expenditures for critical interregional highway routes (due to the limited coverage in the region), $4.460 billion in planned or programmed interregional rail corridors (e.g. Surfliner), and $0.933 billion for goods movement (overlaps with highway investments). SANDAG's RTP includes performance measures which support the "3 Es," including a reliable transportation system that promotes a prosperous economy, healthy environment, and system preservation/safety that considers social equity. Similar to SCAG's Compass Blueprint, the Regional Comprehensive Plan contains targets for density and transit use; however, these specific metrics are not included in the RTP 2030. The region is preparing for their RTP update, planning to reduce GHG emissions and improve air quality through either a Sustainable Communities Strategy or Alternative Planning Strategy (if needed) pursuant to the requirements of SB 375.

SACOG RTP 2035

The Sacramento Area Council of Governments (SACOG) developed the 2050 Sacramento Blueprint in 2004. Through negotiations with the Federal Highways Administration and collaboration with local governments, SACOG was able to base its RTP 2035 on the "hybrid" Blueprint land use pattern that reflected its member jurisdictions' trend toward Blueprint planning principles and development patterns. Of SACOG's $41.7 billion budget for the 2035 RTP, $0.935 billion is planned for the implementation of critical interregional highway routes within the SACOG region; further, SACOG has $2.9 billion planned in other state highway expansions. The 2050 Blueprint/RTP 2035 include performance measures with strong targets supporting the "3 Es," including targets for transit use, VMT/GHG reduction, and housing variety. The region's RTP is based on its preferred growth scenario and invests in transit, roadways, and bike/pedestrian facilities.

San Joaquin Valley RTP 2030

The eight MPOs that comprise the San Joaquin Valley adopted the 2050 San Joaquin Valley Blueprint in 2009. While the 2030 RTPs for each of the MPOs are based on growth projections from the Department of Finance, the region plans to use Blueprint land use forecasts in the upcoming RTP cycle. The San Joaquin Valley plans to invest $29.22 billion in its transportation systems over the next 20 years.

Comparing the RTPs

A comparison of the RTPs and their degree of Blueprint implementation reveal some differences including jobs/housing balance, but on the whole the RTPs are trending towards greater integration of transportation and land use in line with Blueprint visions.

ABAG/MTC, SCAG, SANDAG, and SACOG all project an increase in the disparity between jobs and housing balance regionally, with all four expecting a greater increase in jobs than housing. However, the MPOs within the San Joaquin Valley currently have a more balanced jobs/housing ratio than the other regions with the exception of the Merced County Association of Governments, which has a shortfall of jobs to balance its housing provision. While there is limited data for jobs/housing ratios projected for the 2030 RTP horizon year, the San Joaquin Valley has notably different trends than the other major MPOs regarding balancing jobs and housing. The jobs/housing relationship is particularly relevant in considering interregional travel, since movement to and from work can be a major contributor to travel between regions.

Regardless of their differences, all the plans display a "trend" toward more compact development, lower VMT growth, and more transportation choices. Despite the fact that MPOs and Caltrans have varying performance metrics and objectives, the outcomes yield complementary findings:

- ✓ Reducing light-duty vehicle VMT on state highways reduces GHG emissions within MPOs and increases mobility and economic activity for goods movement via commercial trucking/freight.
- ✓ Compact development reduces light-duty vehicle VMT on state highways by directing vehicle trips to local and regional networks that can support transit ridership and non-motorized travel.

See Appendix C for a full comparison of California's major MPO RTPs and the degree to which they reflect Blueprint planning/smart growth principles.

Highlights of Individual RTPs: Blueprints for Success

While each of the following MPOs has successfully developed a Regional Blueprint, the Sacramento Area Council of Governments' (SACOG) is one of the few MPOs to base their RTP on the land use vision in their Regional Blueprint. SACOG incorporated this vision as the foundation for their 2008 RTP, and used advanced modeling to weigh various policy outcomes and performance measures based on the region's sustainability objectives. SACOG is an example that shows how scenario-based planning can help achieve state and regional performance goals.

SACOG Blueprint and MTP: Lessons Learned

SACOG's Blueprint development offers a model for developing sustainable communities strategies (SCS) under SB 375 that will integrate climate change, transportation, land use and housing plans.*(10)* The region's successes can be categorized into three groups:

1) Plan and Process
2) Modeling Developments
3) Public Participation

Plan and Process

The 1999 Metropolitan Transportation Plan (MTP) reflected the status quo of most RTPs in the nation today. This plan was created by combining the individual transportation plans of SACOG's member cities, counties, and transit operators and modeling regional effects using their traditional four-step travel model (SACMET). After the plan was unanimously adopted by SACOG's Board, the Environmental

Council of Sacramento filed a lawsuit against SACOG challenging the technical details of the air quality conformity finding in light of the plan's focus on roadway capacity projects.*(17)* The settlement favored SACOG with a commitment for improved public outreach for the next MTP cycle.

The 2002 MTP represented SACOG's first step toward integrated land use and transportation planning. In preparation for the plan, SACOG initiated a new travel survey of 4,000 households in the region and used it to update the SACMET travel model.(*17)* The updated model showed that a balanced investment in automobile capacity and other modes performed better than a scenario based solely on capacity. While the 2002 MTP was not challenged with litigation, it did predict a nearly 60 percent increase in per household travel spent in heavy congestion. SACOG attributes this reality among an array of stakeholders to sparking the investigation of how changing land use patterns in the region could lead to smarter investments and less time spent in congestion – this became known as the Blueprint.*(17)*

Modeling Developments

SACOG relied heavily on partnerships in Salt Lake City, Utah where the regional visioning process for integrating land use and transportation had already been evolving. The Envision Utah project provided SACOG with technical and process advice early in the development of the Blueprint.*(17)* The initial stages of the Blueprint were marked by an extensive data collection effort to create a new type of modeling capability that could better assess the dynamic relationship between land use and transportation developments. SACOG also realized that a market research survey was needed on consumer housing preferences in the region. After partnering with the Sacramento Metro Chamber, Urban Land Institute, and Building Industry Association, the survey found that two-thirds of the people over 55 in the sample preferred alternatives to single family homes (e.g. attached units, small lot).*(17)* This became useful information in SACOG's data collection effort to inform their modeling developments. Two types of models were developed for this effort:

1) A land use-economic model that used costs, development policies from general plans, travel time, and household demographics. The creation of this land use model included the collection of 800,000 GIS parcels in the six-county region containing information about general plan / zoning designations and lot size.
2) An updated version of SACMET that better predicted the effects of land use characteristics on travel behavior. This post-processor of the model is called the "4 D's" (i.e. density; diversity; design; destination) and takes vehicle trip reduction into account for smart growth measures.

Public Participation

Another way in which SACOG was successful was through an extensive public outreach campaign that utilized new data and models that staff were developing in order to better inform residents in the region. They used an internet-based software tool developed originally by the California Energy Commission called I-PLACES to allow community members to use the interactive tool at the workshops.*(17)* SACOG utilized this tool to engage local and regional policy-makers in the process of creating a regional vision, enabling SACOG's local jurisdictions to become vested in the plan's purpose.

Utilizing their tools, SACOG went out to thirty neighborhood workshops with the "Base Case/Trend Scenario" which performed poorly on new performance measures such as jobs-housing balance, housing diversity, VMT, air emissions/HH, and mode choice. After the Base Case Scenario was rejected by the majority of the public, staff created three county-level planning scenarios to present at county-level workshops. The Regional Scenarios were then developed and presented at the final regional-level

workshop where 1,500 people attended. The consensus votes at each of the 150 tables favored the scenario that placed the final 20 percent of projected growth in the inner suburban areas (not the inner infill areas or periphery of region).*(17)* Between public workshops, staff at SACOG was working closely with staff from all local jurisdictions.

In December 2004, the SACOG Board unanimously adopted the Blueprint, including a conceptual map for growth through 2050, a set of Blueprint growth principles, and an implementation strategy. Determining the "success" of this Blueprint is a matter of how much weight one places on the high-profile stories of inconsistencies between what and how local jurisdictions ultimately decide to develop.

What is Success? The Dunnigan Example

Perhaps the best example of a local government truly implementing the Blueprint is Yolo County's VMT Threshold for the Dunnigan Specific Plan. As part of the General Plan update, the County identified the Town of Dunnigan (currently 400 existing residential units) as a new Specific Plan area that would accommodate approximately 8,000 new residential dwelling units. The County worked closely with Fehr & Peers to develop a daily household (HH) VMT threshold based on SACOG modeling estimates. Based upon unique project design features that focus on reducing vehicle trips and balancing the jobs/housing distribution, Dunnigan was estimated to generate 44 VMT/HH by 2035 while surrounding areas in the County were estimated to generate 77 VMT/HH by 2035. The 44 VMT/HH figure is roughly equivalent to the average VMT/HH projects within SACOG's Blueprint/MTP. Unlike traditional vehicle level of service (LOS) policies in many of California's General Plans, the Yolo County example ties LOS to VMT *reduction.* Specifically, General Plan Policy CI-3.2 states that the County must identify specific LOS policies within Specific Plans and Community Area Plans based on the following conditions:

- Development shall occur consistent with applicable Land Use and Community Character Element policies.
- Development shall provide transit, bike and pedestrian facilities and amenities consistent with the applicable Circulation Element policies.
- New development shall utilize a grid pattern for local roadways.
- Roadways shall be designed to reduce VMT.

Other Measures of Success

Table 2 highlights how successful the Blueprint has been in implementing SACOG's Board Adopted Action Items, how this has influenced growth at the local level where project implementation occurs, and how other MPOs could learn from SACOG's experiences in the development of a scenario-based RTP that mirrors the requirements of SB 375's Sustainable Communities Strategy.

TABLE 2. SACOG Board Adopted Blueprint Action

Board Adopted Blueprint Action Item	A Success?	Why?
Conceptual Map for Growth through 2050	Yes	Frequently used for visual impact to "tell SACOG's story"
Set of Blueprint Growth Principles	Yes	Adopted into local, state and national plans and have become common platform to establish funding criteria both within and out of California
Work with Legislature to Amend CEQA	Somewhat	While SB 97 and SB 375 both specifically address CEQA, neither will likely incentivize development to the degree needed to redirect market-based development trends
Develop Rural Lands & Open Space Strategy	Yes	Rural Urban Connections Strategy (RUCS) is the economic and environmental sustainability strategy for rural areas with SACOG
Integration of Blueprint into MTP 2035	Yes	MTP 2035 based on "Blueprint-hybrid"
Technical Assistance to Local Governments to Amend General Plans and Zoning Codes	Mostly	• El Dorado County did not participate in Blueprint process, and both the El Dorado County RTPA and Placer County RTPA have independent funding programs from SACOG • The City of Sacramento and the City of Rancho Cordova have since created updates to their General Plans that reflect Blueprint land use • Despite efforts to educate local planners on new practices, outdated zoning codes, ordinances & design guidelines continue to be a problem • That FHWA approved SACOG's the "Blueprint-hybrid" as the reasonably foreseeable land use allocation for the MTP is a sign that SACOG is working with local governments to amend their plans • Yolo County General Plan adopts VMT/HH threshold concurrent with the Blueprint average • Development of resource guides for local governments to update design guidelines to accommodate "complete streets" • Several local-level cases exist where there has been disagreement between SACOG and a local jurisdiction (e.g. Placer Vineyards; US-50 HOV lanes; Covell Village)
Pursuit of Financial Incentives to Promote Infill Development	Yes	MTP includes $2.3 billion for community design incentives, travel demand management programs, open space preservation, and technology deployment. However, to discourage low-cost urban fringe development, a regional program needs to be established and funded to incentivize/charge the true cost of development

Comparing SACOG's 2002 and 2008 RTPs in Tables 3 and 4 shows that the 2004 Blueprint did influence regional funding priorities. Performance metrics, similar to those highlighted in Caltrans' Smart Mobility Framework, such as travel time, transit reliability, air quality, GHG emissions, and VMT all improve in the latest 2035 MTP. However, the regional jobs/housing ratio is trending toward an imbalance of more jobs than housing – consistent with the trends projected in the RTPs for SCAG, SANDAG, and MTC/ABAG. The 2035 MTP also has significant changes for investment priorities, which reflect the changes in performance metrics. In testimony to the US Senate on October 10, 2009, SACOG Director Mike McKeever noted that "these new investments are made possible by reducing the demand for investment in options that serve only single occupant vehicles and allocating a larger share of flexible revenues to alternatives that meet the future set of mobility demands."*(18)*

Influence on Interregional System and GHG reduction

The performance improvements estimated for the 2035 MTP and investment priorities necessary to achieve them will impact the policy and funding direction for Caltrans' interregional transportation system. For example, SACOG estimates a reduction in commercial truck VMT by two percent due to increased investment in rail freight. Further, SACOG found a reduction in *congested* VMT for commercial vehicles by 36 percent, a factor that not only improves economic vitality through goods movement, but also reduces GHG emissions caused by idling or stop-and-go freeway traffic. This is a result of SACOG's 2035 MTP planning for a shift in local travel off of the major interstates onto local arterials, leaving more capacity for longer-distance travel heavily dominated by commercial trucks. Further, in anticipation of this shift of vehicle travel to local arterials, SACOG has developed resources to help local governments update guidelines and codes to implement "complete streets" so that communities can be interconnected by a transportation system that promotes non-motorized travel, transit accessibility, and ADA compliance.

TABLE 3. Comparison of SACOG's RTP Performance: 2002 MTP and 2008 MTP[17]

Comparison of SACOG's RTP Performance: 2002 MTP and 2008 MTP		
Percent Change from 2005 in:	*2025 (2002 MTP)*	*2035 (2008 MTP)*
Transit Service Hours	+111%	+283%
Transit Boardings	+98%	+184%
Transit Productivity	+6%	+35%
GHG / Capita	0%	-8%
Weekday VMT / Capita	+1%	-6%
Congested VMT / Capita	+114%	+16%
Commercial Truck VMT	--	-2%
Congested VMT for Commercial Vehicles	--	-36%

TABLE 4. Comparison of SACOG's RTP Investments: 2002 MTP and 2008 MTP[17]

Comparison of SACOG's RTP Investments: 2002 MTP and 2008 MTP	
	Percent Change from 2002 to 2008 MTP
Transit Investment	+21%
Bike/Ped Investment	+56%
Smart Growth Programs	+35%
Road Operations & Maintenance	+17%

Other Examples from California's MPOs

While SACOG achieved its unique success as one of the few MPOs to base their RTP on the land use vision in their Regional Blueprint, there are many examples of other MPOs taking significant steps to implement Blueprint planning principles.

SCAG Blueprint Compass

The Southern California Association of Governments (SCAG) is an MPO that represents six counties (Ventura, Los Angeles, Orange, San Bernadino and Riverside) and 189 cities. SCAG planning activities seek to serve a current population of over 19 million and future growth of an additional 6 million by 2035. Although the land use base of SCAG's RTP 2035 differs from the preferred growth scenario established in its regional blueprint, the principles adopted in SCAG's "Compass Blueprint" are included in the RTP as advisory land use policies and strategies for consideration by its member jurisdictions (see Appendix C for details on SCAG's RTP).

As discussed earlier, SCAG developed the 2030 Compass Blueprint in 2004, which represents a consensus-supported, regional approach to land use and transportation challenges in Southern California, and was created with stakeholders to reflect local interests and regional values. This vision, now called the Compass Blueprint, includes a "2% strategy" that is a guideline for growth. The strategy includes "modest" changes to land use and transportation trends on 2% of the regional land base and targets "Strategy Opportunity Areas" where projects, plans and policies that are consistent with the Compass Blueprint will best serve the overall goals of sustainable growth.

The Opportunity Areas consist primarily of metropolitan areas, city centers, rail transit stops, rapid transit corridors, airports, ports, industrial centers, infill areas and priority communities (cities not in the 2% zones but ones encouraged to promote actions consistent with the Compass Blueprint principles). Each year since 2006, SCAG recognizes outstanding projects that implement Compass Blueprint principles such as mobility, livability and sustainability.

Among the 2010 contenders, and an excellent example of multijurisdictional planning, is the Arrow Highway Project. This project involved over 20 jurisdictions and agencies in its initial scoping and 6 jurisdictions directly for the final vision and corridor plan. The project's goal was to analyze a corridor, evaluate development options and create implementation tools for improvements that also supported greater connections between land use and transportation.

The project includes 8.5 miles of Arrow Highway, starting at I-605 and traveling through Azusa, Baldwin Park, Covina, Glendora and unincorporated Los Angeles County to end at the western border of San Dimas. Through data from site visits, stakeholder interviews, demographic research, retail studies and extensive document review, the project proponents identified short-term, mid-term and long-term land use changes. The analysis included identifying the role of the corridor and recommended refining it into three districts - industrial, retail and residential - to provide a basic framework to guide redevelopment. The final report considers governmental, circulation and transit, land use, design, and economic issues and develops interrelated and holistic strategies tailored for multi-jurisdictional groups. A full list of candidate projects is available at www.compassblueprint.org/awards2010.

TransNet Smart Growth Incentive Program

In 2005, SANDAG approved $22.47 million in funding as part of the agency's Pilot Smart Growth In-

centive Program. The money support sixteen projects that met the goals of SANDAG's Regional Comprehensive Plan (RCP) to encourage coordinated regional planning to bring transit service, housing and employment together in smart growth development.

Now a longer-term smart growth incentive program (SGIP) is being funded through TransNet, the half-cent sales tax for local transportation projects that was first approved by voters in 1988 and administered by SANDAG. The goal of the TransNet SGIP is to fund public infrastructure projects and planning activities that will facilitate compact, mixed use development focused around public transit, and will increase housing and transportation choices. SANDAG's RCP includes a "Smart Growth Concept Map" illustrating the location of existing, planned, and potential smart growth areas. The SANDAG website includes a downloadable Smart Growth Concept Map to help locate smart growth areas, view photos of existing projects and answer questions. SANDAG also has visual simulations of smart growth to illustrate how areas can be transformed by smart growth development and transit-friendly designs.

The SGIP will award two percent of the annual TransNet revenues (approximately $4.8 million in FY 2009) for the next 40 years to local governments through a competitive grant program to support projects that will help better coordinate transportation and land use in the San Diego region.

CIB PHASE II

SB 391 requires Caltrans to update the California Transportation Plan (CTP) to address how the state will achieve "maximum feasible emissions reductions" consistent with the AB 32 and Executive Order S-3-05. The first update of the CTP must be completed by December 31, 2015 and updated every five years thereafter. Caltrans is required to engage the Strategic Growth Council, ARB, California Transportation Commission, and regional planning/air quality agencies prior to submitting the CTP to the Legislature and Governor for approval. The updated CTP will include elements addressing policy and recommendations for the Plan's broad system concepts, strategies, and performance objectives consistent with SB 391, including:

- Mobility and accessibility
- Integration and connectivity
- Efficient system management and operation
- Existing system preservation
- Safety and security
- Economic development, including productivity and efficiency
- Environmental protection and quality of life

The CIB effort is supported by a package of data and tools now under development (Figure 3) that will measure the affect of planned interregional improvements, in light of future regional land use visions, to determine projected outcomes such as GHG emissions. The first step in the statewide "Model Development Plan" is the 2010 California Household Travel Survey. This survey is a coordinated effort led by Caltrans with the "Big 4" MPOs (SACOG, SANDAG, MTC/ABAG, and SCAG) as well as the eight MPOs that comprise the San Joaquin Valley. The update to the California Household Travel Survey and the models it will inform are essential steps for the development of Sustainable Communities Strategies by the MPOs under SB 375 and for analysis required by SB 391. The survey will update the statewide database of household socioeconomic and travel behavior information – a preliminary task to the development of the statewide Interregional Travel Demand Model (2010), Statewide Freight Model

(2012), and Statewide Integrated Interregional Transportation, Land Use and Economic Model or SIIM (2012).

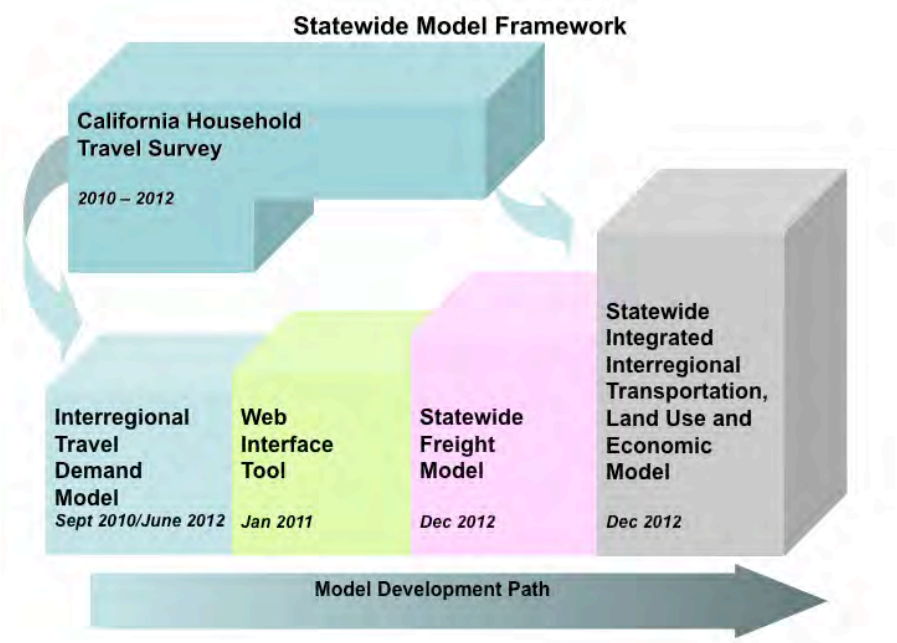


FIGURE 3. Caltrans Model Development Plan[11]

The SIIM will be compatible with the "Big 4" MPO integrated regional models, and will provide the ability to project the impact of statewide policies and investments on regions throughout California and the interaction of regional policy choices and investments with statewide efforts. These MPO models will be able to correspond with the statewide model, and will each offer the benefit of answering questions pertaining to regional projects and statewide policy implications.

IMPLEMENTATION OF CIB

Implementing change will require a review of how policies, funding, guidelines and data come together to support a transition. Regardless of the fact that studies can demonstrate economic improvements with reduced VMT, our current funding structure still links transportation revenue to miles travelled in many ways. Toll fees, gas taxes and local development impact fees rely on increased vehicle travel rather than focuses on reducing VMT. "Success" in transportation has typically been measured by increased capacity rather than more efficient land use strategies that can actually reduce travel demand. Shifting to a transportation paradigm that is much broader than facilitating vehicle travel will require not only legislative mandates, but also accurate information that shows how GHG and VMT reduction can support California's economy, diversity, environmental resources, and overall access to goods movement.

The CIB, by creating a shared forum where regional plans can connect with state transportation projects and policies, helps create the foundation for identifying information gaps and creating an "Action Plan" at a statewide and regional level to get the data needed for better decisions. Here is a place to coordinate agency actions and establish a new precedence for collaboration toward statewide and regional transportation and land use plans. It is a foundation for developing new plans and guidance documents

to support the "3E's" that guide the Smart Mobility Framework, the California Transportation Plan, and regional performance measures – as well as the regulatory and statutory requirements outlined in AB 32, SB 375, and SB 391.

To actualize current policy initiatives and legislative mandates, and create true integration of land use and transportation practices, California policymakers must consider the following questions and possible actions to address them:

- Based on the new vision of MPO plans and legislative requirements, how will state and regional transportation system plans, such as the State Interregional Transportation Strategic Plan and MPO RTPs determine the impact of GHG emission reduction strategies and policy outcomes?

    - ✓ Action: Complete Statewide Transportation Demand Model (STDM), Statewide Freight Model (SFM) and the Statewide Integrated Interregional Model (SIIM) to coordinate modal plans and test GHG reduction solutions

    - ✓ Action: Identify a set of performance measures that are consistent with the legislative intent of AB 32, SB 375 and SB 391 and position the State to receive optimal funding from the performance-based federal transportation reauthorization bill that is in development

    - ✓ Action: Understand the relationships between economic markets, transportation projects, and land use decisions that result in benefits and consequences for an array of performance measures

- Because interregional travel is impacted by regional actions (both through-trips and origin-destination trips), how will interregional plans be developed in light of regional decisions?

    - ✓ Action: Accelerate support for regional integrated models common data development, including the joint California Household Travel Survey and Freight Model

- How can the State support MPOs in resolving capacity planning differences and varying model results for interregional trips on adjoining corridors, and how can the State's High Speed Rail network and feeder transit systems support congestion relief?

    - ✓ Action: Complete STDM and a Web Interface Tool for the STDM allowing MPOs to work with each other and Caltrans to find the best solutions to different approaches

    - ✓ Action: Continue to coordinate interregional modeling efforts with tools and scenarios being developed through the California High-Speed Rail Authority's Vision CA

    - ✓ Action: Collaborate with local and regional stakeholder groups to find solutions that reflect the "3 Es"

- What can the California Interregional Blueprint achieve in the short-term to address *"the state's lack of a comprehensive, statewide, multimodal planning process that details the transportation system needed in the state to meet objectives of mobility and congestion management consistent with the State's GHG emission limits and air pollution standards"* (SB 391).

  - ✓ Action: Compile the best available empirical research on how to reduce GHG emissions while increasing accessibility to goods and services (see Appendix B)

  - ✓ Action: Establish a process for collaboration with MPOs, RTPAs and Caltrans District Offices to examine project priorities in light of new legislative requirements

- What does Caltrans need in order to meet SB 391's December 31, 2012 deadline to submit an interim report providing a list and overview of SCSs and APSs, including an assessment of how their implementation will influence the configuration of the statewide integrated multimodal transportation system?

  - ✓ Action: Assemble a collaborative advisory group consisting of key staff from California agencies

  - ✓ Action: Complete the Statewide Integrated Interregional Model, including the corresponding MPO models

  - ✓ Action: Analyze the affect of each fiscally constrained RTP in the state on the set of performance measures established by Caltrans

- What can the California Interregional Blueprint and California Transportation Plan achieve in both the short-term and long-term to address *"current public transportation services and facilities that are inadequate to meet current and expected future increases in demand"* (SB 391).

  - ✓ Action: Complete the Statewide Transit Strategic Plan currently being developed by Caltrans to articulate a vision and identify an action plan to facilitate the delivery of cost-effective public transit services statewide.

  - ✓ Action: Support enhanced data gathering to link and assess regional/interregional planning, develop funding opportunities linked to new Smart Mobility performance metrics, support continued Regional Blueprint planning efforts leading to land use/transportation choices that support statewide goals of GHG and VMT.

CONCLUSIONS

As noted naturalist and preservationist John Muir once said, “When we try to pick out anything by itself, we find it hitched to everything else in the universe.” And so it is in California. Regional planning affects state planning, state goals are intertwined with regional priorities, and land use decisions affect goods movement. The CIB provides an unprecedented opportunity for transportation planners to integrate visions, policies and priorities so that regional transportation systems are better linked and supportive of statewide goals, and the interregional system integrates with and supports regional goals. Despite previous funding mechanisms linked to more vehicles on roads, newer policies and legislative mandates require a multi-modal California, one whose future is not tied to increased vehicle miles traveled. This change is not only necessary to lower the state’s carbon footprint, but it also supports healthier, affordable communities which in turn stabilize and nourish a strong economy.

This Report is a first step. It is a qualitative review of GHG and VMT reduction policies in transportation and land use, and a window into how scenario-based planning choices can help California achieve current legislative mandates while improving the lives of people throughout the state. It provides a snapshot of the current and proposed interregional transportation system and includes an “Action Plan” based upon Caltrans’ continuing efforts to establish performance criteria, such as cost-effectiveness, greenhouse gas reduction, and improved safety, to guide future transportation investments.

It is, however, only the first step. Scenario-based planning is only beginning to move from collaborative discussion to implemented policy that results in better transportation projects. Even though studies show the GHG reduction benefits from network management, pricing and other strategies, the actual quantitative data has yet to be developed to see how strategies in California are measuring up to the climate change challenge. Phase II of the CIB will provide the necessary data and modeling infrastructure to allow the CIB to progress from qualitative analysis to comparable datasets. It will allow planners at both the regional and state level to work together more effectively, and it will help regions to expand their collaboration. Studies already demonstrate the synergistic effect of combining policies to reduce GHG and VMT. Caltrans has just finished the collaborative process of developing its Smart Mobility Framework with performance metrics to evaluate transportation strategies. Now we can start measuring where we are (baseline), determining where we need to go (vision), and most importantly, deciding what needs to happen next (updated plans) in order for us to get there – to a sustainable California.

REFERENCES FOR NARRATIVE

(1) California Air Resources Board, State of California. AB 32 Climate Change Scoping Plan. December 2008.

(2) California Energy Commission, State of California. 2007 Integrated Energy Policy Report. 5 December 2007. http://www.energy.ca.gov/2007publications/CEC-100-2007-008/CEC-100-2007-008-CMF.PDF Accessed 1 January 2010.

(3) United States Department of Transportation, Federal Highway Administration. *Transportation and Climate Change: Time to Think, Plan, Mitigate, and Adapt.* Transportation Research Board Annual Meeting. January 2010.

(4) Legislative Analyst's Office, State of California. *Unstable Funding Adversely Impacts Transportation Programs. 2009-10 Budget Analysis Series: Transportation.* http://www.lao.ca.gov/analysis_2009/transportation/trans_anl09004002.aspx Accessed 31 January 2010.

(5) Legislative Analyst's Office, State of California. *California Travels: Financing our Transportation.* January 2007. http://www.lao.ca.gov/2007/ca_travels/ca_travels_012607.pdf Accessed 21 January 2010.

(6) LaHood, Ray. Transportation Research Board's Chairman Luncheon. Keynote Speech. 13 January 2010.

(7) High-Speed Rail Authority, State of California. *California High-Speed Rail Authority Report to the Legislature.* December 2009. http://cahighspeedrail.ca.gov/images/chsr/20091223222521_CHSRA_Business_Plan_Dec_2009.pdf Accessed 27 April 2010.

(8) Office of the Governor, State of California. *Gov. Schwarzenegger Announces First Construction Groundbreaking of a Recovery Act Funded Infrastructure Project.* Press Release. 30 April 2009. http://gov.ca.gov/press-release/12167/ Accessed 10 July 2009.

(9) Federal Highways Administration, US Department of Transportation. *The Transportation Planning Process: Key Issues.* FHWA-HEP-07-039. September 2007. http://www.planning.dot.gov/documents/briefingbook/bbook_07.pdf Accessed 19 January 2010.

(10) McKeever, Mike. *Sacramento Region: The Evolution of Integrated Transportation Planning.* Testimony to Congress. 29 October 2009. http://www.sacog.org/calendar/2009/11/12/board/pdf/14-Attach.pdf Accessed 30 October 2009.

(11) Department of Transportation, State of California. *Proposition 84 Funds Application for California Household Travel Survey.* 23 September 2009. http://www.sgc.ca.gov/docs/funding/Caltrans_CHTS_Application.pdf Accessed 23 January 2010.

(12) Pastor, Manuel. Presented at Blueprint Then/Now/Next, 5-year Anniversary of the Sacramento Region Blueprint. http://www.sacregionblueprint.org/implementation/anniversary5/ Accessed 2 April 2010.

(13) Ewing, Reid and Eric Dumbaugh. The Built Environment and Traffic Safety. Journal of Planning Literature, Vol. 23, No. 4, 347-367. 2009.

(14) Ewing, Reid, K. Bartholomew, Steve Winkelman, Jerry Walters and Don Chen. Growing Cooler: The Evidence on Urban Development and Climate Change. Urban Land Institute. 2008.

(15) Ewing, Reid. CO2 Reductions Attributable to Smart Growth in California. University of Maryland and Arthur C. Nelson, University of Utah. September 2008. http://www.climateplanca.org/ewing_analysis.pdf. Accessed 22 July 2009.

(16) Cambridge Systematics, Inc. Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions. Urban Land Institute. July 2009.

(17) McKeever, Mike. Sacramento Region: The Evolution of Integrated Transportation Planning. Testimony to Congress. 29 October 2009. http://www.sacog.org/calendar/2009/11/12/board/pdf/14-Attach.pdf Accessed 30 October 2009.

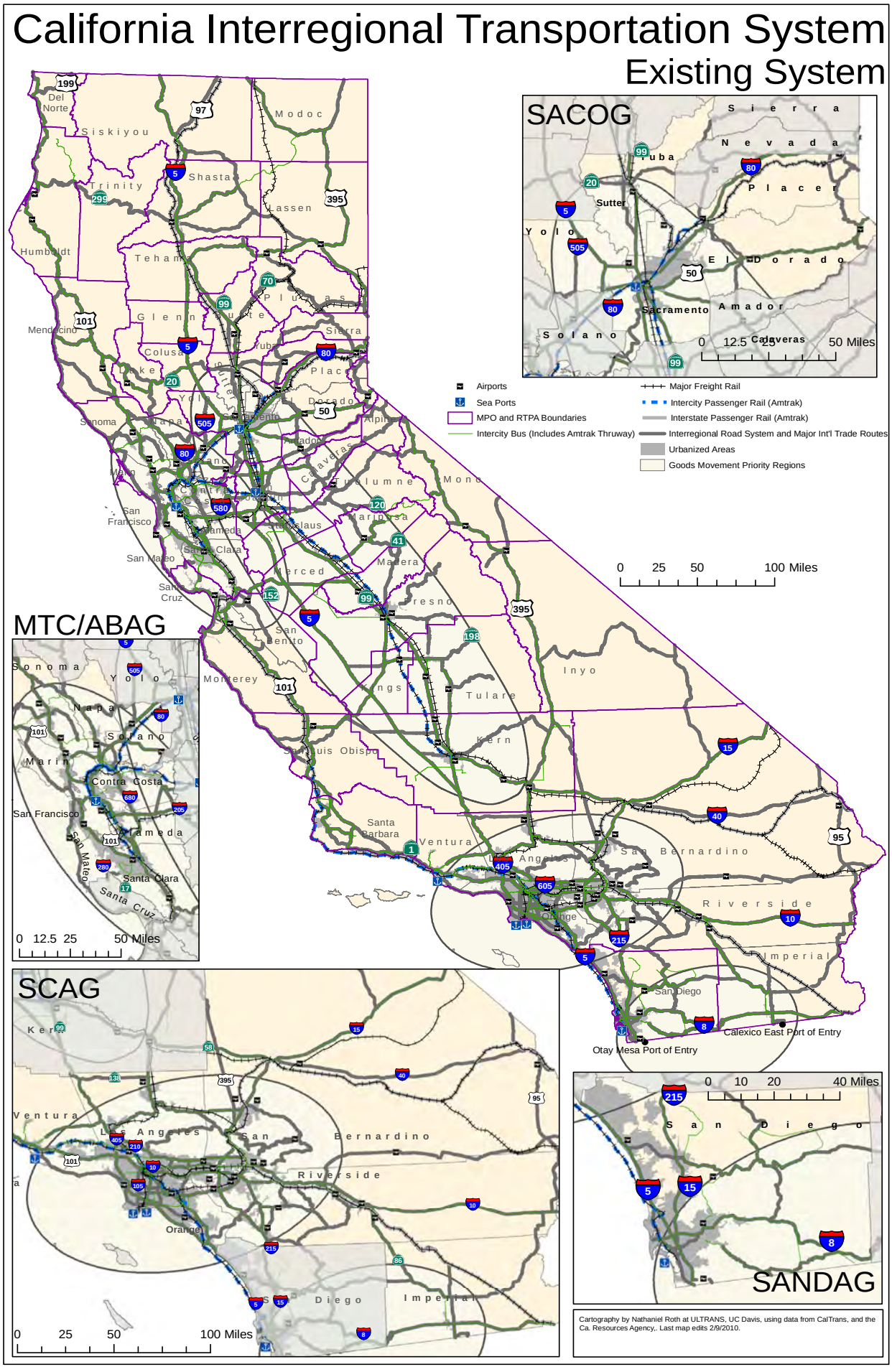
(18) Department of Transportation, State of California. Proposition 84 Funds Application for California Household Travel Survey. 23 September 2009. http://www.sgc.ca.gov/docs/funding/Caltrans_CHTS_Application.pdf Accessed 23 January 2010.

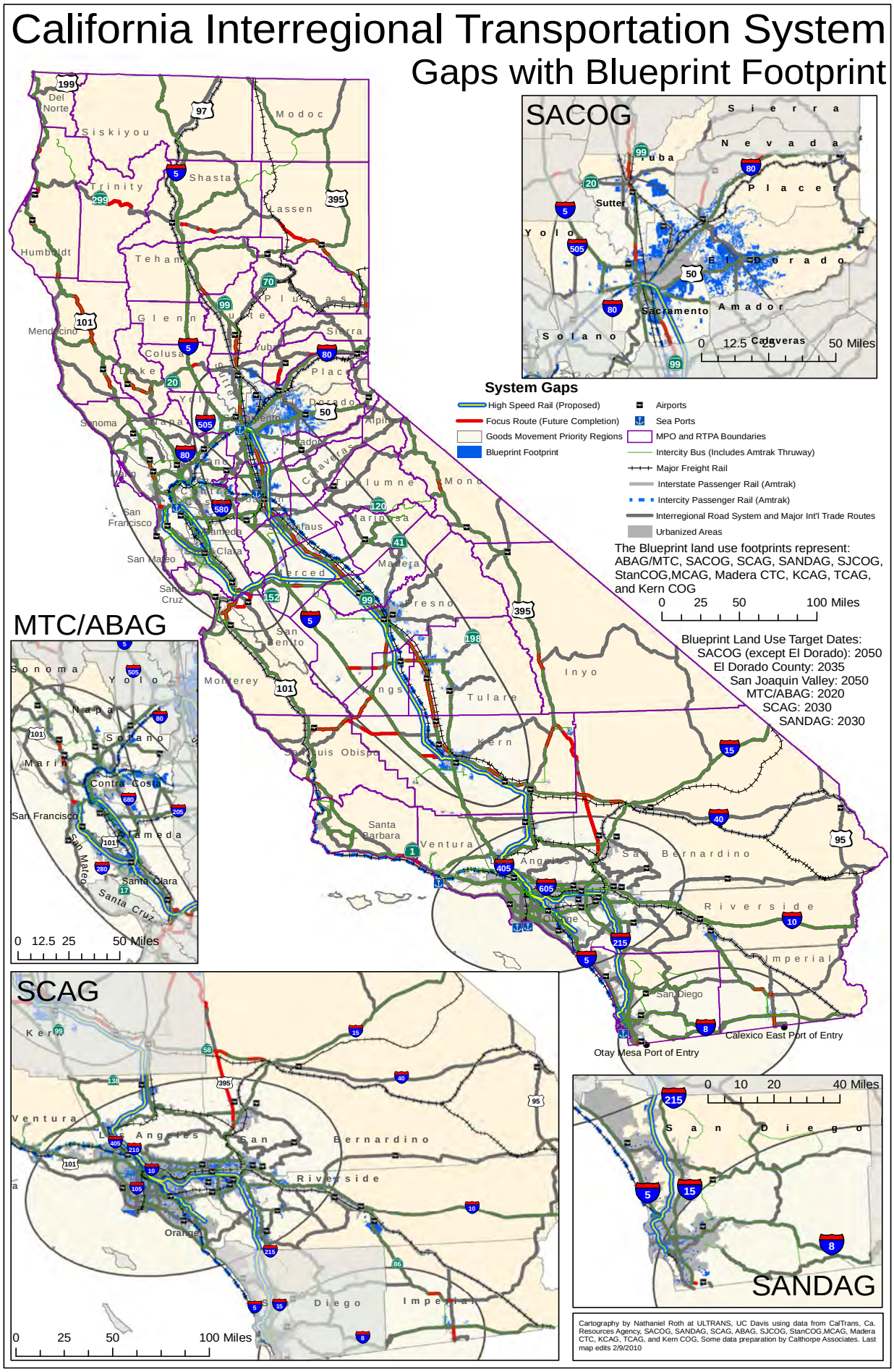
APPENDIX A: MAPS

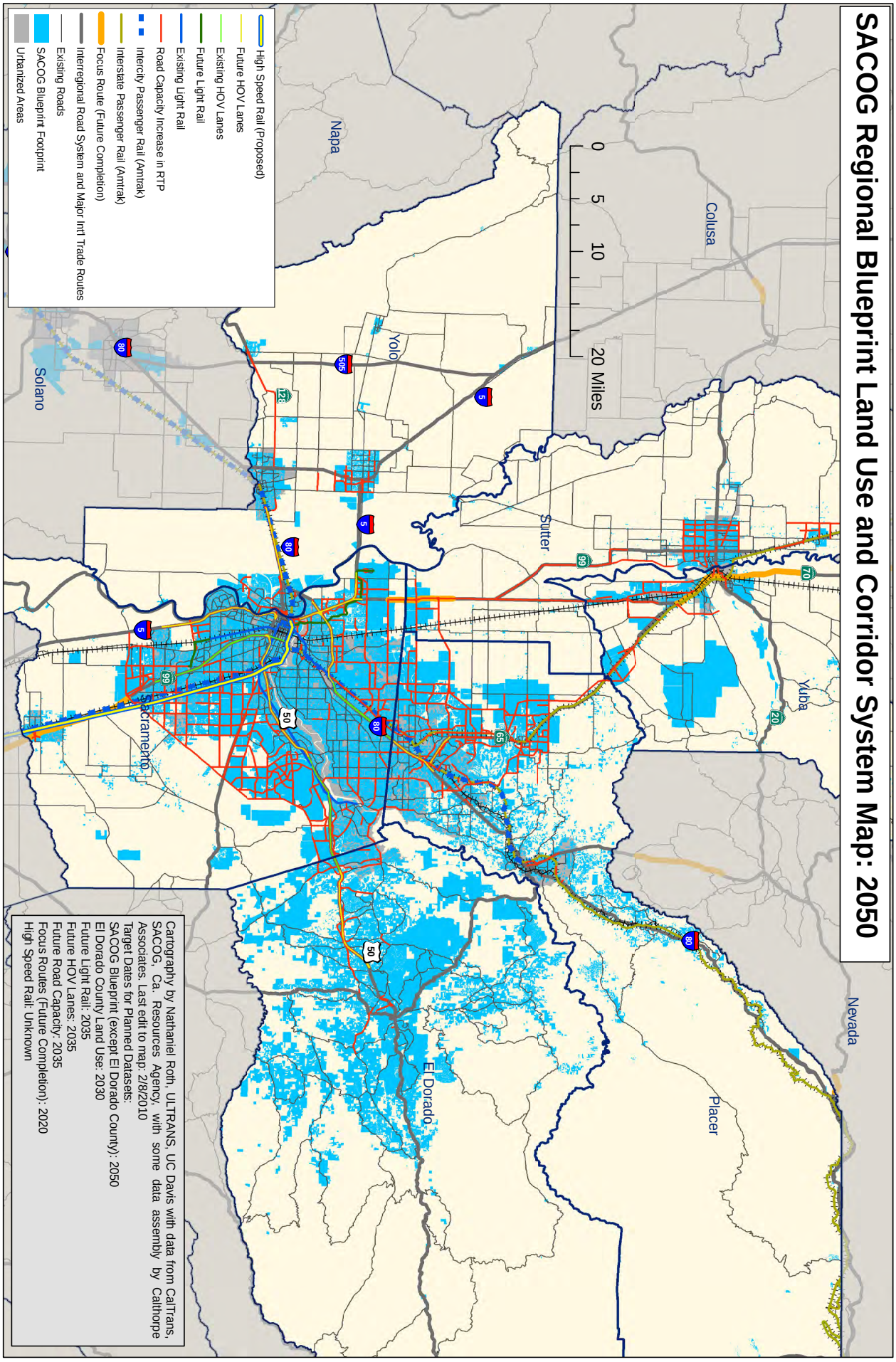
Map 1: California Interregional Transportation System – Existing System ***(Sources: Caltrans Divisions of Transportation Systems Information, Transportation Planning, and Mass Transportation, California Spatial Information Library and Calthorpe Associates)***

Map 2: California Interregional Transportation System Gaps with Blueprint Footprint ***(Sources: Caltrans Divisions of Transportation Systems Information and Transportation Planning, Calthorpe Associates, California Spatial Information Library, Sacramento Area Council of Governments, Southern California Association of Governments, San Diego Association of Governments, Association of Bay Area Governments, San Joaquin Council of Governments, Stanislaus Council of Governments, Merced County Association of Governments, Madera County Transportation Commission, Council of Fresno County Governments, Tulare County Association of Governments, Kings County Association of Governments, and Kern Council of Governments)***

Map 3: SACOG Regional Blueprint Land Use and Corridor System Map: 2050 ***(Sources: Caltrans Divisions of Transportation Systems Information and Transportation Planning, Calthorpe Associates, California Spatial Information Library and Sacramento Area Council of Governments)***


California Interregional Transportation System
Existing System
SACOG
MTC/ABAG
SCAG
SANDAG
Airports
Sea Ports
MPO and RTPA Boundaries
Intercity Bus (Includes Amtrak Thruway)
Major Freight Rail
Intercity Passenger Rail (Amtrak)
Interstate Passenger Rail (Amtrak)
Interregional Road System and Major Int'l Trade Routes
Urbanized Areas
Goods Movement Priority Regions
0 25 50 100 Miles
0 12.5 25 50 Miles
0 10 20 40 Miles
Otay Mesa Port of Entry
Calexico East Port of Entry
Cartography by Nathaniel Roth at ULTRANS, UC Davis, using data from CalTrans, and the Ca. Resources Agency,. Last map edits 2/9/2010.


California Interregional Transportation System
Gaps with Blueprint Footprint
SACOG
MTC/ABAG
SCAG
SANDAG
System Gaps
High Speed Rail (Proposed)
Focus Route (Future Completion)
Goods Movement Priority Regions
Blueprint Footprint
Airports
Sea Ports
MPO and RTPA Boundaries
Intercity Bus (Includes Amtrak Thruway)
Major Freight Rail
Interstate Passenger Rail (Amtrak)
Intercity Passenger Rail (Amtrak)
Interregional Road System and Major Int'l Trade Routes
Urbanized Areas
The Blueprint land use footprints represent: ABAG/MTC, SACOG, SCAG, SANDAG, SJCOG, StanCOG,MCAG, Madera CTC, KCAG, TCAG, and Kern COG
0 25 50 100 Miles
Blueprint Land Use Target Dates:
SACOG (except El Dorado): 2050
El Dorado County: 2035
San Joaquin Valley: 2050
MTC/ABAG: 2020
SCAG: 2030
SANDAG: 2030
Otay Mesa Port of Entry
Calexico East Port of Entry
0 12.5 25 50 Miles
0 25 50 100 Miles
0 10 20 40 Miles
Cartography by Nathaniel Roth at ULTRANS, UC Davis using data from CalTrans, Ca. Resources Agency, SACOG, SANDAG, SCAG, ABAG, SJCOG, StanCOG,MCAG, Madera CTC, KCAG, TCAG, and Kern COG, Some data preparation by Calthorpe Associates. Last map edits 2/9/2010


SACOG Regional Blueprint Land Use and Corridor System Map: 2050
High Speed Rail (Proposed)
Future HOV Lanes
Existing HOV Lanes
Future Light Rail
Existing Light Rail
Road Capacity Increase in RTP
Intercity Passenger Rail (Amtrak)
Interstate Passenger Rail (Amtrak)
Focus Route (Future Completion)
Interregional Road System and Major Int'l Trade Routes
Existing Roads
SACOG Blueprint Footprint
Urbanized Areas
0 5 10 20 Miles
Napa
Colusa
Yolo
Solano
Sutter
Yuba
Sacramento
El Dorado
Placer
Nevada
Cartography by Nathaniel Roth, ULTRANS, UC Davis with data from CalTrans, SACOG, Ca. Resources Agency, with some data assembly by Calthorpe Associates. Last edit to map: 2/8/2010
Target Dates for Planned Datasets:
SACOG Blueprint (except El Dorado County): 2050
El Dorado County Land Use: 2030
Future Light Rail: 2035
Future HOV Lanes: 2035
Future Road Capacity: 2035
Focus Routes (Future Completion): 2020
High Speed Rail: Unknown

APPENDIX B:

GHG REDUCTION STRATEGIES FROM TRAVEL BEHAVIOR

APPENDIX B. GHG REDUCTION STRATEGIES FROM TRAVEL BEHAVIOR

This Appendix outlines the existing research to date on GHG reduction strategies and the methodologies to estimate these reductions/impacts, and introduces policy barriers at various levels of government that pose obstacles to achieving a comprehensive reductions in GHG emissions from transportation network management and VMT reduction.

The Foundation under the "Third Leg of the Stool"

This appendix illustrates how a "Four Circle Approach" to GHG reduction can support climate change stability, economic relief, and communities that encourage healthier lifestyles. The approach groups GHG reduction strategies into four categories:

1) Characteristics of the Built Environment: "6 Ds,"
2) Pricing Policies,
3) Suppressed Roadway Capacity, and
4) Vehicle Traffic and Speed Management.

The first three circles represent VMT reduction strategies, while the fourth captures network management strategies. As illustrated in the overlapping of the four circles in the center of Figure 1 , strategies to address travel behavior are inter-related and greater reductions occur when they are co-implemented. For example, if infill development (Characteristics of the Built Environment) is implemented without an incremental price signal (Pricing Policies) then the GHG emissions reductions would be less than with pricing policies because there would be less incentive toward shorter trips. This appendix explores the literature regarding the dynamics between such variables and what ranges in GHG reduction are reasonable based on varying assumptions for future growth trends.

The Four Circles are defined as follows:

1) *Characteristics of the Built Environment* (VMT Reduction) – factors of an existing or planned neighborhood development project that contribute to a reduction in VMT from a baseline estimate. These characteristics may include the "6 D's:" density, design/site accessibility, destination/regional accessibility, diversity in land uses, distance to transit, and demographics.

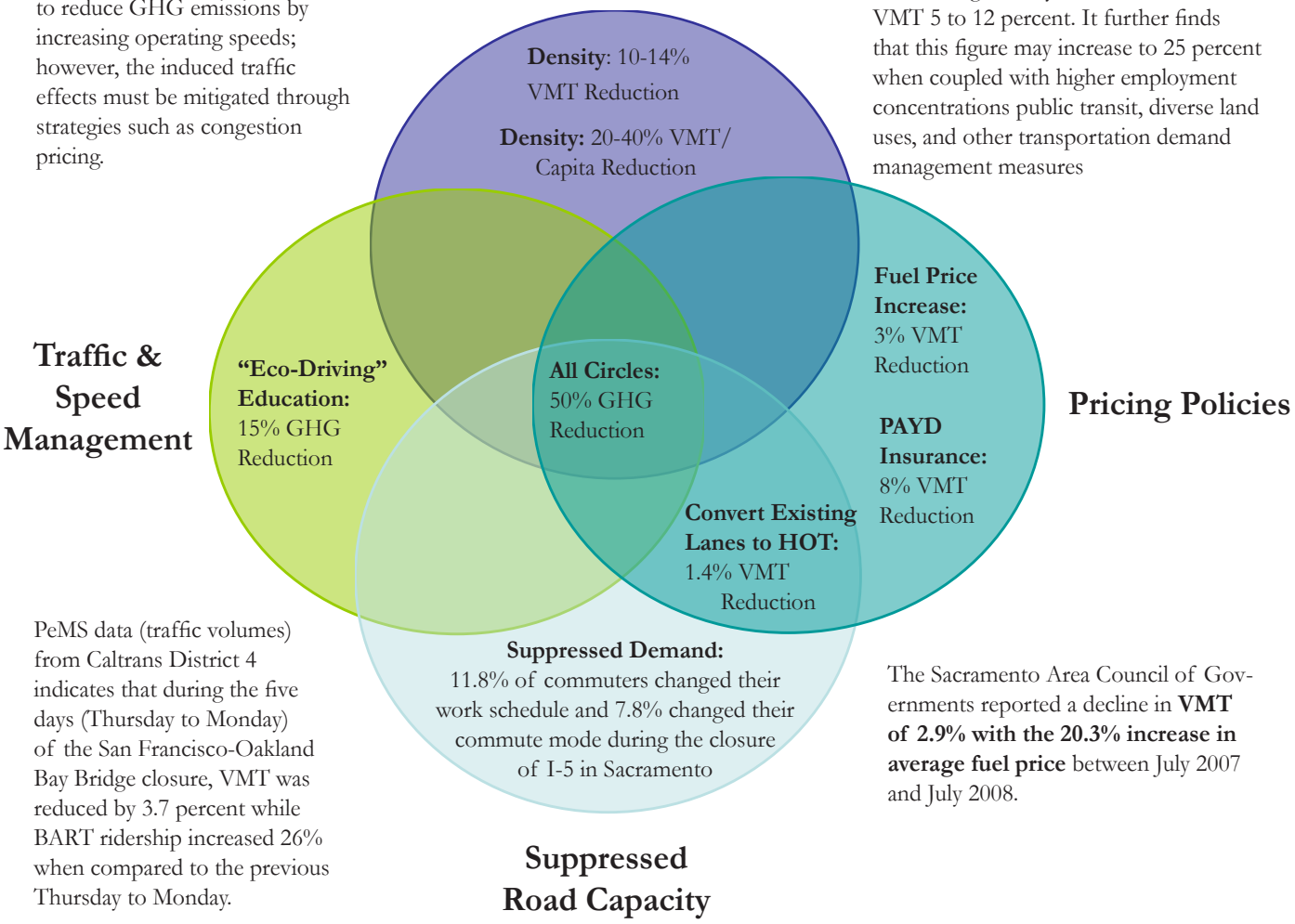
2) *Pricing Policies* (VMT Reduction) – mechanisms at the local/regional (e.g. parking policies) and state/national (e.g. carbon tax) level reduce GHG emissions while generating revenue by sending economic signals to consumers.

3) *Suppressed Roadway Capacity* (VMT Reduction) – slows the growth in VMT by prioritizing maintenance and operations on state highways systems and regional/local roadway facilities over added capacity from additional single- or high-occupancy vehicle (SOV/HOV) lanes.

4) *Traffic and Speed Management* (Network Management) – while the first three circles address reducing the growth in VMT, this addresses HOW people drive in terms of speed and vehicle maintenance and how infrastructure and operational changes in the roadway network affect driving behavior.

A TRB study finds that efforts to reduce congestion and improve traffic flow through system operations or intersection treatments have the potential to reduce GHG emissions by increasing operating speeds; however, the induced traffic effects must be mitigated through strategies such as congestion pricing.

A TRB study funding by the U.S. Department of Energy analyzed the relationship between land use patterns and vehicle travel. The results find that reliable estimates for doubling residential density across a region may lower household VMT 5 to 12 percent. It further finds that this figure may increase to 25 percent when coupled with higher employment concentrations public transit, diverse land uses, and other transportation demand management measures



PeMS data (traffic volumes) from Caltrans District 4 indicates that during the five days (Thursday to Monday) of the San Francisco-Oakland Bay Bridge closure, VMT was reduced by 3.7 percent while BART ridership increased 26% when compared to the previous Thursday to Monday.

The Sacramento Area Council of Governments reported a decline in **VMT of 2.9% with the 20.3% increase in average fuel price** between July 2007 and July 2008.

FIGURE 1. Four Circle Approach to GHG Reduction from Travel Behavior

GHG Reduction from Travel Behavior Strategies: Methods and Research

There are three primary types of methodologies that can be used in the short and/or long term to assess the GHG impacts from land use and transportation strategies: 1) Empirical Data/Studies, 2) Technical Models, and 3) Simple Tools. These methodologies are compared on the basis of how GHG emissions are quantified, what current and developing examples exist, ability to meet objectives required under SB 375, and major limitations. An exhaustive literature and tool review reveals that there is a wide range of GHG reduction ranges from singe and combined transportation and land use strategies. This section summarizes the latest estimates in GHG reduction from empirical data/studies, simple tools, and technical models.

Empirical Data/Studies

Empirical data describes existing research on GHG impacts from land use and transportation strategies, which mainly consist of cross-sectional evidence showing how *differences* in the built environment are associated with *differences* in vehicle-miles-travelled (VMT) or GHG emissions. There are several fundamental research papers which examine the existing literature on empirical data, including:

- Ewing, Bartholomew, Winkelman, Walters, and Chen's *Growing Cooler: The Evidence on Urban Development and Climate Change* (2008)
- Bartholomew and Ewing's *Land Use-Transportation Scenario Planning: A Meta-Analysis* (2009)
- Transportation Research Board's *Driving and the Built Environment: The Effects of Compact Development on Motorized Travel, Energy Use, and CO2 Emissions* (2009)
- Urban Land Institute's *Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions* (2009)

Empirical data is necessary in order to provide the sound science for SB 375 implementation because it is the basis for any chosen methodology by the California Air Resources Board (ARB) in the short or long term, and is crucial for validating these other approaches. The major limitation of this method is the lack of "intervention" research (i.e. before/after studies) which shows the *change* in VMT or GHG emissions of a particular setting resulting from a *change* in the built environment, rather than relying on how *differences* among built environment characteristics affect *differences* in VMT or GHG.

Current research on using travel behavior strategies to reduce GHG emissions indicate that combining measures has a much higher effect on emissions reduction than implementing single policy strategies. This is due to the interactive effects between strategies such as compact development and pricing mechanisms. *Growing Cooler: The Evidence on Urban Development and Climate Change* provides an analysis of the combined effect of compact development and transportation strategies based on elasticities from the Texas Transportation Institute. They show a "Low Carbon Scenario" for 2030 that includes slowing highway capacity growth by a third while doubling transit capacity, development density, and fuel prices. This combination yields a 38 percent combined reduction in VMT from the trend scenario. *(*1) In Ewing's *CO2 Reductions Attributable to Smart Growth in California,* the GHG reductions for 2020 from compact development alone range from 3.4 to 4.7 percent.*(2) Growing Cooler* estimates that making reasonable assumptions about growth rates, market share of compact development, and the relationship between VMT and carbon dioxide, compact development could reduce total transportation-related GHG emissions from current trends by seven to ten percent in 2050 and US VMT by 10 to 14 percent. *(*1*)* In *Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions*, the analysis finds that under maximum deployment of the "long-term/maximum results bundle," which combines most of the 50 measures evaluated, GHG emissions can drop 24 percent without strong economy-wide pricing measures.*(3)* With a nationwide price signal, such as fuel taxes equivalent to those in Europe, a 52 percent reduction would be possible.*(*3*)*

Required under the Energy Policy Act of 2005, the United States Department of Energy (DOE) funded the Transportation Research Board (TRB) to analyze the relationship between land use development patterns and vehicle travel in *Special Report 298: Driving and the Built Environment: The Effects of Compact Development on Motorized Travel, Energy Use, and CO2 Emissions*. This August 2009 study finds that reliable estimates for doubling residential density across a region may lower household VMT by 5 to 12 percent; further, it finds that this figure may increase to 25 percent when coupled with higher employment concentrations, public transit, diverse land uses, and other transportation demand manage-

ment measures.*(4)* Additionally, the University of Utah's Metropolitan Research Center conducted a "meta-analysis" in which they found a range of 20 to 40 percent VMT reduction per capita from compact development based on existing literature ranges.*(5)*

Table 1 compares results from recent synthesis of fundamental research on GHG reduction from single and combined compact development policy scenarios. However, the lack of uniformity in reduction range units and baseline/trend assumptions makes it difficult to compare data across existing research. Much of the variation in reduction ranges is attributed to the what transportation researchers believe are feasible assumptions regarding market or political changes that move toward compact development, transit ridership, and macro-level pricing schemes. For instance, *Special Report 298* assumes average densities for residential development will decrease while Ewing's analysis is based on trends that move toward more compact development rather than away. When applying VMT reductions to strategies in California, careful consideration should go into what a reasonable assumption is for converting VMT to a carbon dioxide reduction (i.e. California's mild climate will result in less of an impact from cold starts affecting GHG emissions than in other parts of the country).

TABLE 1. Comparison of Recent Syntheses from Empirical Studies on GHG Impacts

Strategy		GHG Reduction: 2050 Baseline TRB's SR 298[4]	GHG Reduction: 2050 Baseline Growing Cooler[1]	GHG Reduction: 2050 Baseline Ewing et all[5]	GHG Reduction: 2050 Baseline Moving Cooler[3]
Compact Development (without transit or pricing)		(1-11% VMT)	7-10% (12-18% VMT)	7-10% (17% VMT)	0.2-4.4%
Baseline/Trend Assumptions					
Methodology for 2050 Trend from 2005 Baseline		•National Resources Inventory & Census data used to estimate density •Applied VMT reduction ranges across 3 Scenarios	Developed elasticity figures from various case studies	Developed a regional VMT model based on 85 scenarios in 23 planning studies from 18 regions	•Combines existing research & strategies •No original methodologies applied
2050	Average Density	Method A: 1.1 DU/ urban acre Method B: 2.89 DU/ acre	based on proportional changes	based on proportional changes	based on proportional changes
2005	VMT/HH Reduction	5-12% from density; 25% combined with transit	--	--	--
2050	Compact Development as Share of Total	Scenario 1: 25% Scenario 2: 75%	60% - 90%	60% - 90%	60% - 90%
2050	Residential Growth Rate	30%	70%	70%	70%
2050	Non-Residential & Mixed Use Growth Rate	0% (only assumes residential density rates)	130% (based on combined residential and non-res rates of 200%)	130% (based on combined residential and non-res rates of 200%)	130% (based on combined residential and non-res rates of 200%)
2050	VMT Location	Inner Suburbs, Transit Stops, and Major Highway Corridors/ Interchanges	80% in Urban Areas	80% in Urban Areas	80% in Urban Areas
2020	Vehicle Efficiency	Energy Independence and Security Act (EISA) 2007	EISA 2007	EISA 2007	EISA 2007
2020	Low Carbon Fuel	EISA 2007	EISA 2007	EISA 2007	EISA 2007

Technical Models

Technical models include travel demand models or integrated economic, land use, and transportation models with sensitivity to characteristics of the built environment that affect travel behavior (e.g. 4 D's: density, diversity, design, and destination). The first of these types of models (travel demand models with 4D's) have been used to estimate GHG impacts on land use and transportation policy choices, and are best summarized in Caroline Rodier's *A Review of the International Modeling Literature: Transit,*

Land Use, and Auto Pricing Strategies to Reduce Vehicle Miles Traveled and Greenhouse Gas Emissions (2008).

The second of these types of models is currently under development at the California Department of Transportation (Caltrans). This stateside integrated economic, land use, and transportation model is being developed to support SB 375 implementation by helping policy makers understand the economic and equity impacts of various strategies in addition to the GHG impacts. ARB and MPOs also reinforce the importance of integrating co-benefits such as public health, open space preservation, and smarter investments into the public engagement process. Integrated modeling will be necessary for any long term understanding of the tradeoffs between various policy choices in California and their co-benefits.

The most common limitation expressed regarding modeling capabilities is that models are best suited for comparing various policy options, and providing approximate estimates for future impacts. There is a wide range of travel demand modeling capability among local jurisdictions and MPOs – few of them contain sensitivity to characteristics of the built environment, and virtually none are sensitive to induced travel demand or growth from capacity expansion policy choices. The statewide integrated economic, land use, and transportation model is limited due to relatively high initial costs for development and data gathering, and the estimated completion date is not until September 2012.

Table 2 compares short-term and long-term modeling estimates for GHG reduction associated with various transportation and land use strategies. This table is based on Rodier's comprehensive literature review of existing reduction ranges found from travel modeling.

TABLE 2. Modeling Estimates for GHG Impacts from Policy Scenarios (Rodier Analysis)

Strategy		Median GHG Percent Reduction from Trend: 10-yr horizon[9]	Median GHG Percent Reduction from Trend: 40-yr horizon[9]
Single Policy Scenarios			
Built Environment Characteristics	Transit	0.3%	1.0%
	Land Use	0.5%	1.7%
Pricing Policies	Cordon Pricing	2.8%	1.7%
	Parking Pricing	2.2%	2.0%
	Congestion Pricing	2.3%	3.8%
	VMT Pricing/PAYD+	9.86%	11.1%
	Fuel Tax	8.4%	12.9%
Combined Policy Scenarios			
Built Environment Characteristics	Land Use & Transit	3.9%	15.8%
Pricing Policies	Pricing: Parking, VMT, Congestion	4.5%	16.6%
Built Environment Characteristics & Pricing Policies	Transit & Pricing	10.3%	17.1%
	Land Use, Transit & Pricing	14.5%	24.1%

+Pay as You Drive Insurance

Simple Tools

Simple tools are an application of empirical results, and include sketch planning and interactive spreadsheet tools that are capable of providing a less technically rigorous analysis than sophisticated modeling, but are useful for the public engagement process. Examples of simple tools in California to support SB 375 implementation include the sketch planning tool, *Vision California*, sponsored by the California Strategic Growth Council (SGC) and California High Speed Rail. While this sketch planning tool is not substitutable for sophisticated modeling in terms of quantifying GHG impacts, it does provide a useful medium for public involvement. Additionally, *Vision California* will complement more technically rigorous approaches, because the land use information will be used as part of the initial run of the Caltrans integrated model (Statewide Integrated Interregional Transportation, Land Use, and Economic Model).

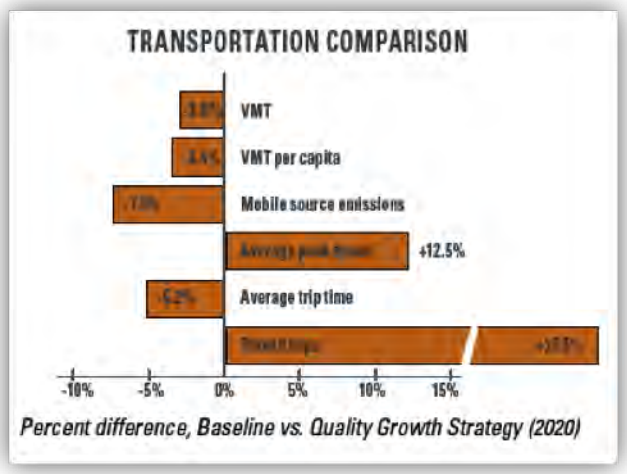
Another example of a simple tool is what ARB is referring to as a "policies and practices" tool (formerly known as "best management practices"). Researchers are currently developing tools that will analyze the GHG impacts of land use and transportation strategies using characteristics of the built environment. These tools will rely on empirical data, include the cumulative GHG impacts of combining multiple strategies, and will have a "context-sensitive" application built into them. The limitation of sketch planning tools is that they lack the sophisticated relationships between land use and transportation systems and the underlining economic theory that the Caltrans statewide model will be built upon. Sketch planning tools are thus best suited for the public engagement process to explain general changes resulting from policy choices. Additionally, of other simple tools such as a "policies and practices" tool, lack the capability to address co-benefits, economic impacts, and social equity effects of policy strategies. Simple tools are not widely accepted by experts in the transportation field as technically rigorous stand-alone methods for assessing GHG impacts, however, they are a useful short-term solution for understanding crude estimates for GHG reduction strategies.

Implementing GHG Reductions

While research studies show that combined strategies to alter travel behavior have a significant role in reducing GHG emissions, there is an array of implementation challenges. Characteristics of the built environment (6 Ds), pricing policies, and suppressed roadway capacity deal with performance metrics that ultimately affect VMT, while traffic and speed management affect system efficiency. Understanding the degree to which these challenges can be overcome will help local and national policy-makers prioritize incentives in transportation, metropolitan and local planning processes. It is important to note that with the cumulative GHG reductions that result from combining multiple strategies, incentives in each circle are necessary to successfully direct travel behavior choices that favor GHG reduction.

First Circle: Characteristics of the Built Environment

The first circle focuses on how characteristics of the built environment influence VMT reduction. These characteristics can apply to existing or planned neighborhood development projects, and include the "6 D's:" **d**ensity of the project, **d**esign of the project (accessibility within site), regional accessibility to the project **d**estination, **d**iversity in project's land uses (mixed uses shorten trips/change mode), **d**istance to transit (within ½ mile), and **d**emographics of the project area (age, income effects). Shifting funding priorities toward land use and transportation infrastructure can promote compact community design and a lifestyle that allows people to more easily incorporate non-vehicular choices into their daily trip making. Characteristics of the built environment that reduce VMT include increased transit frequency, access to goods and services through mixed-use and transit-oriented development, and complete networks of bike lanes and sidewalks.



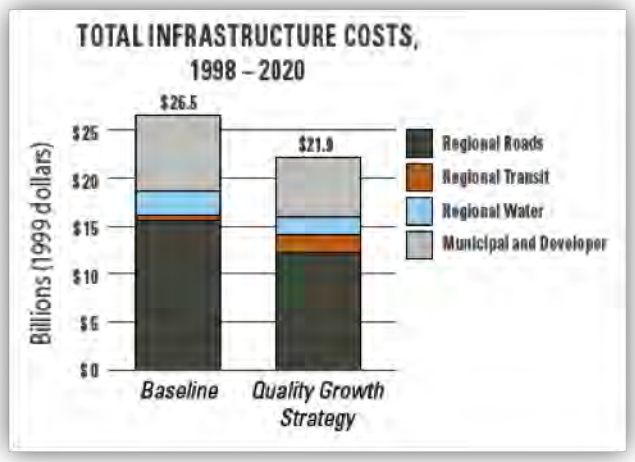


FIGURE 2. Conditions under Adopted Salt Lake City's "Envision Utah" Regional Plan[10]

Furthermore, compact development is estimated to reduce VMT *per capita* 20 to 40 percent when compared to a low-density alternative.*(1)* Often touted as the best example of integrated transportation and land use planning development in the country, the metropolitan area of Portland, Oregon generated 23.6 VMT per capita in 2000 while the low-density Raleigh-Durham region generated 31.0 VMT/capita in the same year *(1)* – a difference of 24 percent. Within the SACOG region, the average weekday VMT per household (HH) and associated driving costs vary drastically based upon the area type. "Downtown" and "downtown adjacent" areas which generally have greater densities and mixes in land use produce 11-23 VMT/HH and average 5-10 percent transportation expenditure from HH median income, while "commuter suburbs" generate 58-74 VMT/HH and consume 20-25% of average HH median income.*(11)* "Envision Utah" was a scenario-based regional visioning process that arose from an effort to engage residents and plan for the rapid growth in the greater Salt Lake City region. The adopted "Quality Growth Strategy" for the region estimates a savings of nearly $5 billion from reduced infrastructure expenses, and a three percent decrease in total VMT from baseline trends over a twenty-year horizon.*(10)* Compact communities reduce greenhouse gas emissions and costs through the reduction of VMT.

Transit service, frequency, and convenience also play a key role in characteristics of the built environment that influence travel behavior. Several TRB studies have found that a 10 percent reduction in bus fares increases ridership by an average of 3.6 percent in cities of over one million residents, and by 4.3

percent in cities of less than one million residents *(12)* and a ten percent reduction in light and heavy rail fares result in 3 percent and 1.7 percent increases in ridership, respectively.*(13)*

The California Energy Commission's (CEC) *2006 Integrated Energy Policy Report Update* notes that the "single largest opportunity to help California meet its statewide energy and climate change goals resides with smart growth."*(14)* Combing GHG reductions from the "6 D's" with additional measures could have the greatest potential to influence travel behavior. However, successful implementation would need to address the role and impact of local general plan policies, transportation impact procedures, street design standards, and local politics. While Regional Blueprint plans create strong visions for a sustainable and integrated land use/ transportation system, the unfortunate reality is that there are many existing barriers and disincentives for jurisdictions and developers in creating the developments outlined in these plans. Because local jurisdictions maintain land use regulatory authority, they can also stall implementation.

Second Circle: Pricing Policies

The second circle examines why pricing policies are important for both maximizing GHG emissions reductions and generating revenue for governments. Federal or state price signals, such as an increased gas tax, have widespread effects on individual behavior and development markets. A national and/or statewide price signal could also be implemented through a gas price floor, which applies a surcharge to transportation fuel creating a reasonable and expected price range for consumers.*(15)* For instance, while the federal fuel tax has not been increased since 1993, the idea of a "Fuel Price Stabilization Program" could help to reduce California's budget deficit.*(*15*)* Regional and local pricing programs, such as cordon charging or parking fees, can deal directly with congestion and traffic flow efficiency effects on GHG emissions. With the current economic budget crises in California affecting both state and local government operations, macro-level pricing policies such as an increase in fuel taxes, a gasoline price floor, or a cap and trade program could help to alleviate a portion of the budget shortfall.

National, state, and local sources of data reflect a decline in vehicle fuel consumption as a result of peak fuel prices in 2008 that were nearly 50 percent higher than the average price in 2007.*(11)* This increase in price led to a decrease in VMT and increases in transit ridership – with nearly all transit operators reporting 10 to 20 percent increases when compared to the same months in 2007.*(*11*)* The Sacramento Area Council of Governments (SACOG) reported a 2.9 percent decline in VMT with the 20.3 percent increase in average fuel price between July 2007 and July 2008.*(*11*)* These finding are roughly consistent when converted to a GHG metric with short-run price elasticities in the 2000s, which range from a 3.4 to 7.7 percent reduction in per capita gasoline consumption for every 10% price increase in fuel. *(16)* Consistent with these findings, a STATA regression analysis of the relationship between real price of gasoline and gasoline consumption per capita over four decades reveals four distinct demand curves where the slope of the 1970s curve is significantly more elastic (i.e. curve is less steep) than that of the 2000s. One conclusion to draw from this is that land use patterns since the 1970s have been declining in average density and as a result communities have become more auto-dependent – this is consistent with data from the National Resources Inventory and US Census data showing similar trends in declining US average densities.

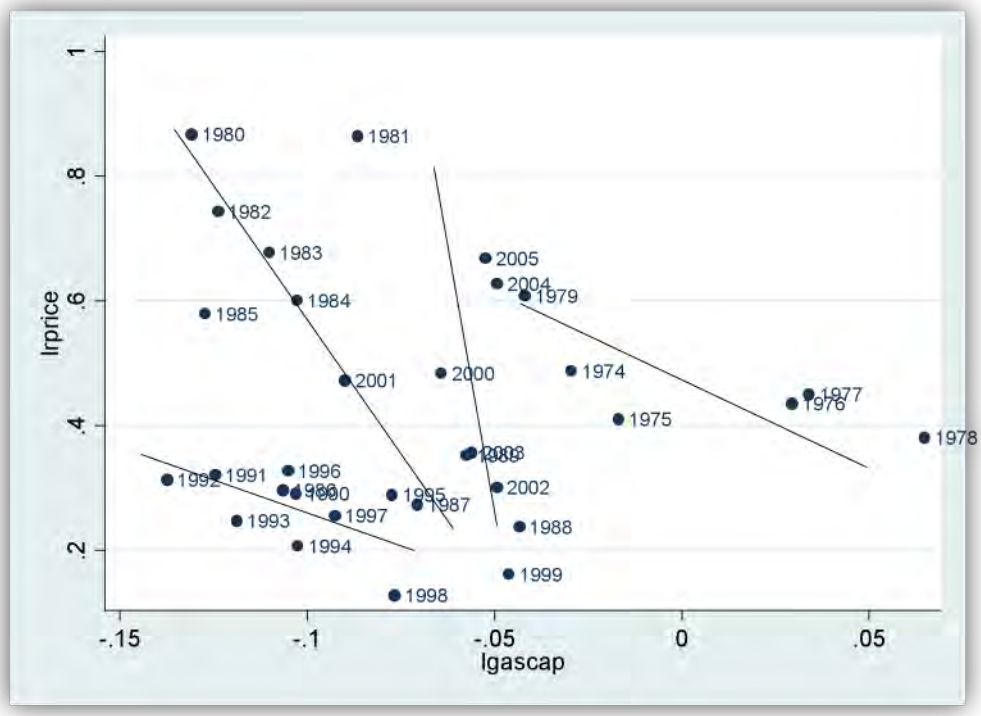


FIGURE 3. Elasticities for Gasoline Demand vs Fuel Prices: 1974-2008

While VMT has continued to decline during the economic recession, the growth in vehicle travel is expected to rise in varying degrees depending on the type of economic activity in various regions. Thus, concepts like a fuel tax or gas price floor have potential to reduce VMT similarly to the increase in fuel prices in 2008. To address equity issues associated with the rising cost of what is arguably considered to be a normal good (i.e. necessity) under current land use patterns, an increase in fuel taxes could be an incremental increase spanning several years rather than an immediate and one-time increase. The United States could implement a "Fuel Price Escalator" similar to the United Kingdom's so that a gradual increase in the fuel price would not dramatically affect consumers in the near term. With the insolvency of the Highway Trust Fund, a Fuel Price Escalator or "Fuel Price Stabilization Program" *(*15*)* could become a significant revenue source for a new "Low Carbon Transportation Fund" where dedicated revenue serves GHG-reducing transportation and land use projects.

Pricing mechanisms at regional and local levels can also influence travel behavior. Transport for London estimates that since the central London congestion charge took effect in 2003, the city has achieved a 6.5 percent reduction in carbon dioxide emissions.(*17)* The United States Environmental Protection Agency estimates that a VMT fee of $0.02 per mile would reduce overall VMT by up to 5.6 percent.*(18)* According to the Brookings Institute, changing all car insurance policies to Pay-as-You-Drive Insurance can save consumers and insurance companies up to $50-60 billion annually, while reducing VMT by 8 percent and reducing crash rates.*(19)* Employers in Southern California saw a 12 percent reduction in commute VMT when they offered a parking cash option to their employees.*(20)* A Transit Cooperative Research Program Report indicates that if the price of parking is doubled, solo driving can be expected to decrease by approximately 10-30 percent.*(21)*

A GHG reduction strategy could combine pricing policies and the "6 D's." This could take the form of a "Carbon Impact Fee" for developers who choose to build on the urban fringe, with the funding

generated used to incentivize development near transit within urban cores.*(1)* In California, the 35 Air Quality Management Districts already have legal authority to implement such a carbon fee. While pricing mechanisms at any level of government can be difficult to implement due to the political nature of constituents, evidence suggests that the public may actually favor taxes that directly fund transportation. Over the last 25 years, voters in 20 California counties passed local transportation sales tax measures that generated approximately $2.5 billion annually for roadway and/or transit projects.*(22)* With the web of institutional changes needed to support implementation of a Regional Blueprint, pricing mechanisms may be quicker and easier to implement in the near-term for GHG reduction. Additionally, pricing strategies could help struggling local and state governments fund needed GHG reducing projects. Because combined GHG reduction strategies complement each other, implementing the "6 D's" strategies would be greatly strengthened once federal, state, regional, and/or local pricing mechanisms are in place to support them.

Third Circle: Suppressed Roadway Capacity

The CEC's *2007 Integrated Energy Policy Report* states that to reduce GHG emissions, California must begin reversing the current two percent annual growth rate of vehicle miles traveled.*(*23*)* The third circle shifts funding priorities away from VMT growth (added vehicle infrastructure capacity) toward prioritizing maintenance-based "Fix it First" and network management (fourth circle) policies at multiple levels of government.*(*1*)* The added capacity from additional Single-Occupancy Vehicle (SOV) or High-Occupancy-Vehicle (HOV) lanes reduces travel times and costs, resulting in attracting trips from other routes and modes, and encouraging longer and more frequent travel.*(23)* A ten percent increase in lane-miles under short-term conditions can cause up to a four percent increase in VMT, and a ten percent increase in lane miles under long-term conditions can cause up to a ten percent increase in VMT.*(24)* PeMS data (traffic volumes) from Caltrans District 4 indicates that during the five days (Thursday through Monday) of the San Francisco-Oakland Bay Bridge closure, VMT was reduced by 3.7 percent when compared to the previous Thursday through Monday. Since the Bay Bridge equates to 1.2 percent of the total lane miles in Caltrans District 4, this example roughly illustrates that for every one percent reduction in lane-miles there is a 3 percent reduction in VMT; further, if this suppressed demand is inverted, we can also conclude that for every one percent *additional* lane-miles there is a three percent *increase* in VMT. The Bay Bridge's suppressed travel demand example also included a 26 percent increase in BART ridership during the closure – again, as compared to the previous Thursday through Monday. This information is important when crafting policies such as the provision of added capacity from additional HOV lanes – a more prudent policy may be to convert existing SOV lanes to HOV lanes, contingent on a comprehensive VMT/speed bin or GHG analysis of the tradeoff between emissions associated with suppressed demand and congestion. Furthermore, the increase in accessibility can induce growth, particularly in areas on the fringe of urban centers. Without roadway capacity expansion, development typically occurs in a more compact design reliant on existing infrastructure.

The University of California, Davis surveyed approximately 5,000 commuters affected by the one-mile northbound and southbound closures of the I-5 "boat section" during a seven week period during the summer of 2008. The study found that 48 percent of commuters avoided rush hour and 44 percent changed their route.*4142)* Approximately 11.8 percent of commuters telecommuted, compressed their work schedule, or increased vacation days, while 7.8 percent of commuters changed their commute mode to transit (5.4%), bicycling/walking (2.5%), or car/vanpooling (1.4%). In a follow-up survey six months after the closure, the study found that 8.3 percent of respondents use transit more for their commute.*(26)*

With existing transportation infrastructure falling into disrepair all across the county, "Fix it First" and network management policies at the federal, state and local levels could create significant GHG reduction from resurfacing and maintaining existing roadway infrastructure. Economically, these policies are significantly less expensive than creating new lanes. While studies show there can be short-term GHG reduction from added roadway capacity and bottleneck relief, the cumulative nature of GHG impacts require analyzing additional capacity beyond a 40-year horizon in which the GHG reduction benefit is limited.*(3)* Further, converting existing lanes to HOV or High-Occupancy-Toll (HOT) lanes can reduce VMT up to 1.4 percent *(18)* while simultaneously funding a "Low Carbon Transportation Fund" to further support innovative strategies in any of the circles. The common argument for roadway capacity expansion is rooted in the notion that people do not like congestion. While this is somewhat true, and a mindset in the barriers to implementing Regional Blueprints and good project design, it is unfair and expensive to limit people's options to one mode, particularly one that decentralizes goods and services that communities' need. Slowing the rate of VMT growth through roadway capacity is critical to support good characteristics of the built environment, pricing mechanisms, and traffic management.

Fourth Circle: Traffic and Speed Management

The fourth circle is unique because it is the only one that addresses how people actually drive and strategies that can stabilize vehicle operating speeds, rather than how to reduce the amount of vehicle miles travelled. Traffic and speed management strategies can be embraced by all levels of government to optimize the amount of gallons of fuel burned per mile through the concept of "network management" or "system efficiency." This includes strategies such as roadway maintenance (including "Fix it First"), education regarding driving at efficient speeds and tire pressures, coordinated traffic operations, changes in speed limits and roadway design (e.g. roundabouts) to create traffic flow stability, and programs to incentivize the purchase of more fuel efficient vehicles. Such measures include lowering speed limits to minimize GHG emissions, educating the public on how vehicle maintenance and handling of their automobile affects fuel economy, and creating intelligent transportation systems (ITS) such as coordinating traffic lights and metering on-ramps. The *Moving Cooler* study found that in total, these three transport system efficiency measures can reduce GHG emissions 3.7 percent to 6.9 percent from a 2050 baseline trend.*(3)*

The study also found that "eco-driving" alone could reduce GHG emissions up to 2.7 percent.*(3)* However, a recent TRB study reports that eco-driving can reduce emissions by up to 15 percent, though the effectiveness may decline over time without additional educational training efforts.*(27)* Additional reductions accrue with more efficient intersection types, such as changing signalized intersections to roundabouts. A study by Tony Redington on opportunities for modern roundabouts to address climate change concluded that 25 roundabouts replacing existing traffic signals in the City of Burlington, Vermont would provide over 20 percent of the city's overall 10 percent reduction in GHGs below 1990 levels.*(28)* The CEC released an "Energy Aware Planning Guide" in December 2009 that includes a suite of transportation and land use strategies to reduce GHG emissions and energy use from vehicles. One such strategy includes traffic signal timing, and the report cites that cities participating in California's Fuel Efficient Traffic Signal Management Program reduced fuel consumption by 7.8 percent.*(29)*

The *International Transport Forum* and the Organisation for Economic Co-operation and Development's *Joint Transport Research Centre* has released a report that includes the preliminary findings of a work group exploring transportation GHG emissions reduction strategies. Similar to the "Four Circle Approach," this report includes the examination of transport GHG reduction in terms of traffic man-

agement, demand management policies (including land use), and mode shift.*(27)* The report concludes that efforts to reduce congestion and improve traffic flow through operations or intersection treatments have the potential to reduce GHG emissions by increasing operating speeds; however, it notes that the induced traffic effects must be mitigated through strategies such as congestion pricing.*(*27*)* Converting existing highway/freeway lanes to HOV or HOT lanes would optimize existing infrastructure by either encouraging people to carpool or allowing single occupancy vehicles to pay a price to use the facility – the latter being an example of a traffic management strategy that combines capacity constraint with a pricing mechanism to ensure stable vehicle operating speeds and suppressed travel demand.

In addition to the GHG benefits from speed management, safety is another performance metric that correlates with decreases in vehicles speed. Reid Ewing and Eric Dumbaugh report that the traffic environments of dense urban areas are safer than lower-volume environments in the suburbs due to lower vehicle speeds and more "pedestrian-oriented" street designs.*(30)* Further, the authors find the 85 percent of vehicle/pedestrian collisions result in a pedestrian fatality when vehicles are travelling 40 mph – this reduces to 45 percent at 30 mph, and 5 percent at 20 mph.*(*30*)*

Based on empirical research and modeling estimates, it is feasible for significant reductions in VMT and GHG emissions to result from strategies such as compact development, increased access to goods and services, pricing policies, reduced growth in roadway capacity, and transportation system efficiency through speed and traffic management measures. This effect is compounded when strategies are combined. Despite the large range in baseline trend assumptions for GHG reduction ranges from land use strategies, it is still evident that if policy trends and new markets emerge toward smart growth planning practices, we can expect approximately ten percent GHG emissions reduction from this new form of development alone. Communities should be empowered to combine strategies from each of the Four Circles illustrated in Figure 1 in order to suit their particular needs.

Table 3 includes a detailed literature review regarding the dynamics between such variables and what ranges in GHG reduction are reasonable based on varying assumptions for future growth trends.

TABLE 3. Empirical Data, Modeling Estimates, and Other Studies of GHG Impacts from Policy Scenarios

Strategy		VMT Reduction: Various Estimates	VMT Reduction: 2050 Baseline	Median GHG Reduction: 10-yr horizon[9]	Median GHG Reduction: 40-yr horizon[10]	GHG Reduction: 2050 Baseline[3]
Single Policy Scenarios						
Built Environment Characteristics	Transit	--	--	0.3%	1.0%	1.1%
	Land Use	--	1-11%[4] 12-18%[3] 17%[5] 7-10% GHG[3,5]	0.5%	1.7%	0.2% to 4.4%
	Bike/Ped	--	--	--	--	0.2% to 0.5%
Pricing Policies	Cordon	--	--	2.8%	1.7%	--
	Parking Fees	--	--	2.2%	2.0%	--
	Congestion Pricing	6.5% (GHG)[18]	--	2.3%	3.8%	0.8% to 1.8%
	PAYD+	8%[20]	--	9.86%	11.1%	1.2% to 4.4%
	Fuel Tax	3%[16]	--	8.4%	12.9%	17%
	VMT Fee	5.6%[19]	--	--	--	--
	Parking Cash Out	12%[21]	--	--	--	--
Traffic / Speed Management	Speed Limit Reduction	--	--	--	--	2.0% to 3.6%
	Eco-driving	15%[29]	--	--	--	1.1-2.7%
	Traffic Light Synchronization	7.8% (GHG)[27]	--	--	--	0.6%
Suppressed Roadway Capacity	Highway Capacity Expansion & Bottleneck Relief	--	--	--	--	.02% *increase*++
	Convert Lanes to HOV/HOT	1.4%[19]	--	--	--	--
	Bay Bridge Closure	3%	--	--	--	--
	I-5 Closure	7.8%[27]				
	Increased Lane-Miles	4-10% *increase*++[26]	--	--	--	--

Strategy	VMT Reduction: Various Estimates / Studies	VMT Reduction: 2050 Baseline	Median GHG Reduction: 10-yr horizon[9]	Median GHG Reduction: 40-yr horizon[10]	GHG Reduction: 2050 Baseline[3]
Combined Policy Scenarios					
Built Environment Characteristics (Land Use & Transit)	--	25%[4]	--	3.9%	15.8%
Pricing Policies (Parking, VMT, Congestion)	--	--	--	4.5%	16.6%
Built Environment Characteristics (Land Use & Transit) & Pricing Policies	--	--	--	10.3%	17.1%
Built Environment Characteristics (Land Use and Transit) Pricing Policies & Suppressed Roadway Capacity	--	38%[3]	--	14.5%	24.1%
Built Environment Characteristics (Land Use & Transit) Pricing Policies & Traffic / Speed Management	--	--	--	--	--

+Pay as You Drive Insurance

++While highway capacity expansion and bottleneck relief had some short-term GHG reduction, the study concluded that this strategy was the only one out of fifty to *increase* GHGs in the long-term due to induced demand

*These results indicate maximum deployment under the "long-term/maximum results bundle

Summary

Based on empirical research of existing communities, it is feasible for significant reductions in VMT and GHG emissions to result from strategies such as compact development, increased access to goods and services, pricing policies, reduced growth in roadway capacity, and transportation system efficiency through speed and traffic management measures. This effect is compounded when strategies are combined. Despite the large range in baseline trend assumptions for GHG reduction ranges from land use strategies, it is still evident that if policy trends and new markets emerge toward smart growth planning practices, we can expect approximately 10 percent GHG emissions reduction from this new form of development alone. Communities should be empowered to combine strategies from each of the Four Circles to suit their particular needs. While studies and modeling estimates both indicate varying levels of certainty into the role land use and transportation strategies play in GHG reduction, two major factors remain:

1) How will the State make decisions based on limited information?
2) How can we ensure that these strategies can be implemented under our current land use/transportation framework, environmental review process, and funding structure?

The following short and long term approach for SB 375 implementation through State agencies is based on the state of the research and practice on the topic of GHG reduction from land use and transportation strategies:

Prepare: Invest in integrated modeling and better empirical data now.
Measure: Perform intervention research that measures before/after effects of strategies now.
Educate: Engage the public first with results from empirical research and sketch planning tools, and later with integrated modeling so they can first see "estimated GHG reduction impacts" and later see "estimated GHG/equity/economic impacts" of policy choices as SB 375 implementation evolves.
Incentivize: Invest in proven strategies that show reductions AND are equitable and cost-effective. Draw from integrated modeling and empirical data.
Repeat: Continue to invest in integrated modeling updates, conduct/support empirical data research, educate the public as integrated modeling results become available, re-prioritize investments as new knowledge appea

REFERENCES FOR APPENDIX B

(1) Ewing, Reid, K. Bartholomew, Steve Winkelman, Jerry Walters and Don Chen. *Growing Cooler: The Evidence on Urban Development and Climate Change*. Urban Land Institute. 2008.

(2) Ewing, Reid. *CO2 Reductions Attributable to Smart Growth in California*. University of Maryland and Arthur C. Nelson, University of Utah. September 2008. http://www.climateplanca.org/ewing_ analysis.pdf. Accessed 22 July 2009.

(3) Cambridge Systematics, Inc. *Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions.* Urban Land Institute. July 2009.

(4) Transportation Research Board, National Academy of Sciences. *Driving and the Built Environment: The Effects of Compact Development on Motorized Travel, Energy Use, and CO2 Emissions.* August 2009.

(5) Bartholomew, K. and R. Ewing. *Land Use-Transportation Scenario Planning: A Meta-Analysis.* Journal of the American Planning Association. 75(1), 13-27. September 2009.

(7) Transportation Research Board, National Academy of Sciences. *Driving and the Built Environment: The Effects of Compact Development on Motorized Travel, Energy Use, and CO2 Emissions.* August 2009

(8) Ewing, Reid, K. Bartholomew, Steve Winkelman, Jerry Walters and Don Chen. *Growing Cooler: The Evidence on Urban Development and Climate Change*. Urban Land Institute. 2008.

(9) Rodier, Caroline J. *A Review of the International Modeling Literature: Transit, Land Use, and Auto Pricing Strategies to Reduce Vehicle Miles Traveled and Greenhouse Gas Emissions.* Institute of Transportation Studies, University of California, Davis. Research Report UCD-ITS-RR-08-34. November 2008.

(10) Calthorpe Associates and California High Speed Rail Authority. *Vision California Brochure.* September 2009. http://www.calthorpe.com/files/Vision%20California%20Brochure%20v2.pdf Accessed 1 January 2010.

(11) Sacramento Area Council of Governments. *Impact of Gas Prices on Transportation Behavior*. August 2008. http://www.sacog.org/calendar/2008/08/07/transportation/pdf/14-Gas%20Prices.pdf Accessed 20 December 2009.

(12). The Demand for Public Transit: A Practical Guide. Transportation Research Laboratory, Report 593. Washington: Transportation Research Board. 2004.

(13) McCollom, Brian and Richard Pratt. *Chapter 12 – Transit Pricing and Fares." TCRP Report 95: Traveler Response to Transportation System Changes.* Washington: Transportation Research Board. 2004.

(14) California Energy Commission, State of California. *2006 Integrated Energy Policy Report.* January 2007. http://www.energy.ca.gov/2006publications/CEC-100-2006-001/CEC-100-2006-001-CMF.PDF Accessed 1 January 2010.

(15*)* Borenstein, Severin. *The Implications of a Gasoline Price Floor for the California Budget and Greenhouse Gas Emissions*. Center for the Study of Energy Markets Working Paper #182, University of California Energy Institute, November 2008. http://www.ucei.berkeley.edu/PDF/csemwp182.pdf Accessed 20 December 2009.

(16) Hughes, Jonathan, Christopher Knittel, Daniel Sperling. *Evidence of a Shift in the Short-Run Price Elasticity of Gasoline Demand.* The Energy Journal, Vol. 29, No.1. 2008.

(17) Transport for London. *Central London Congestion Charging: Impacts Monitoring*, *Sixth Annual Report*. July 2008. http://www.tfl.gov.uk/assets/downloads/sixth-annual-impacts-monitoring-report-2008-07.pdf Accessed 14 July 2009.

(18) Organisation for Economic Co-operation and Development. *Saving Oil in a Hurry*. 2005. www.iea.org/textbase/Papers/2008/cd_energy_efficiency_policy/5-Transport/5-SavingOil2005.pdf Accessed 08 July 2009.

(19) Bordoff, Jason E. and Pascal J. Noel. *Pay-As-You-Drive Auto Insurance: A Simple Way to Reduce Driving-Related Harms and Increase Equity*. Brookings Institution. July 2008 http://www.brookings.edu/~/media/Files/rc/papers/2008/07_payd_bordoffnoel/07_payd_bordoffnoel.pdf. Accessed 15 July 2009.

(20) Shoup, Donald C. *The High Cost of Free Parking*. Journal of Planning Education and Research, Vol. 17, No. 1. 1997.

(21) Vaca, Erin and J. Richard Kuzmyak. *Parking Pricing and Fees.* Chapter 13, TCRP Report 95. Transit Cooperative Research Program. Washington: Transportation Research Board. 2005.

(22) Crabbe, Amber, Rachel Hiatt, Susan Poliwka, Martin Wachs. *Local Transportation Sales Taxes: California's Experiment in Transportation Finance*. Submitted to February 19, 2005. http://www.uctc.net/papers/737.pdf. Accessed 10 July 2009.

(23) California Energy Commission, State of California. *2007 Integrated Energy Policy Report.* 5 December 2007. http://www.energy.ca.gov/2007publications/CEC-100-2007-008/CEC-100-2007-008-CMF.PDF Accessed 1 January 2010.

(24) Robert G. Schiffer, M. Walter Steinvorth, Ronald T. Milam. *Comparative Evaluations on the Elasticity of Travel Demand*. Transportation Research Board 2005 Annual Meeting. 2005. http://www.trb-forecasting.org/papers/2005/ADB40/05-0313_Schiffer.pdf. Accessed 09 July 2009.

(25*)* Litman, Todd. *Generated Traffic and Induced Travel: Implications for Transport Planning*. Victoria Transport Policy Institute. 3 February 2009. http://www.vtpi.org/gentraf.pdf. Accessed 10 July 2009.

(26) Mokhtarian, Pat. *Commuter Impacts & Behavior Changes due to the Fix I-5 Reconstruction Project*. Presentation to the California Air Resources Board. http://www.arb.ca.gov/research/seminars/zhang-mokhtarian/mokhtarian.pdf. Accessed 04 March 2010.

(27) Transportation Research Board. *Reducing Transport GHG Emissions: Opportunities and Costs.* December 2009. http://www.internationaltransportforum.org/Pub/pdf/09GHGsum.pdf Accessed 21 December 2009.

(28) Redington, Tony. *Modern Roundabouts, Global Warming, and Emissions Reductions: Status of research, and opportunities for North America.* Agency of Transportation, Montpelier, Vermont. 2001. http://www.nh.gov/oep/resourcelibrary/referencelibrary/r/roundabouts/documents/vermontctrfpaper.pdf. Accessed 25 July 2009.

(29) Skabardonis, Alexander. *ITS Benefits: The Case of Traffic Signal Control Systems*. Presented at the 80th Annual Transportation Research Board meeting. Washington: Transportation Research Board. 2001.

(30) Ewing, Reid and Eric Dumbaugh. *The Built Environment and Traffic Safety*. Journal of Planning Literature, Vol. 23, No. 4, 347-367. 2009.

APPENDIX C:

COMPARISON OF REGIONAL TRANSPORTATION PLANS

RTP	SACOG	SANDAG	ABAG (COG – land use) MTC (MPO – transport)	SCAG
RTP Base Year	2006	2004	2006	2003
RTP Horizon Year	2035	2030	2035	2035
RTP Budget	$41.7 billion	$58 billion	$218 billion	$186.7 billion
Expected / Adopted	2008	2007	April 2009	2008
Blueprint Visioning Done Prior to RTP	2050 Sacramento Blueprint (2004)	Smart Growth Concept Map (2008); 2030 Regional Comprehensive Plan (2004)	FOCUS Growth Vision (2008); 2020 Smart Growth Strategy (2002)	Compass Blueprint 2030 (2004); Regional Comprehensive Plan 2035 (2008)
Blueprint Visioning Details	Blueprint based on parcel-level PLACE3S land use with 18 place types; product was regional land use map for guiding planning and smart growth principles	Regional Comprehensive Plan (RCP) includes "Smart Growth Opportunity Areas" in 7 place types; SGCM is framework for prioritizing public land use and transportation investments in region	FOCUS Vision created "Priority Development Areas" and "Priority Conservation Areas" – Agencies are directing investments and incentives to PDAs and PCAs	Regional Growth Vision built from 14 place types; technical and planning assistance for local governments to adopt RGV; "2% Strategy Opportunity Areas" include transit and Compass Blueprint Priority Communities
RTP Scenarios	No Build (No Project); RTP Plan (MTP2035 Plan)	Revenue-Constrained ($41B); RTP Plan/Reasonably Expected Revenue ($58B); Vision/Enhanced Smart Growth Land Use (Transit Emphasis & Transit Emphasis Urban Core)	Alternative Land Use; Base	No Build (2003 baseline); Baseline/Pipeline (2035 baseline); RTP Plan (Plan 2035); Envision Scenario
Adopted RTP Scenario	RTP Plan / MTP2035 Plan	RTP Plan / Reasonably Expected	Base	RTP Plan (Plan 2035)
Regional Land Use Allocation Projections	2035 Regional Growth Forecast (hybrid Blueprint/General Plans) used for RTP Plan	2030 Regional Growth Forecast (existing General Plans) used for Revenue-Constrained and RTP Plan Scenarios; Additional 90,000 housing units included in Vision Scenario (standard forecasts located units outside region as X-I trips)	2035 Base forecast of Projections 2007, a policy-based forecast for jobs and housing allocation	SCAG 2008 Integrated Growth Forecast has replaced Regional Growth Vision for determining population, jobs, and housing projections; includes "Baseline Growth Forecast" (RTP Plan) and "Policy Growth Forecast" (Envision Scenario)
What Extent is Adopted RTP Based on Blueprint Land Use?	Through negotiations over conformity issues with FHWA's "reasonably foreseeable land use allocation" requirements and US EPA's 8-hour ozone attainment and SIP requirements, RTP Plan could only adopt the Blueprint land use that was consistent with local government's commitment to implement vision	Land use assumptions are based on existing General Plans, which make up 40% of the "existing or planned" SGCM growth areas	Land use assumptions are "broadly consistent with existing General Plans, but also assumes a more smart growth based projection" (ABAG, 2007)	Little to None -- Policy Growth Forecast based on Compass Blueprint land use and principles, but was not adopted or included as an RTP Scenario; RTP based on Baseline Growth Forecast which includes BAU development trends absent any policy changes. However, RCP is a policy document that supports the integration of Compass Blueprint principles in the RTP by setting policies through collaboration with local government
RTP PLACE3S (place types) Scenario-Based?	Yes, informed regional growth employment and housing projections for 2035 MTP	Yes, RCP includes 7 smart growth place types	Yes, informed ABAG's regional housing and jobs forecasts	Compass' "Regional Growth Vision" forecasting model based on 14 place types – this was not used for RTP

RTP	SACOG	SANDAG	ABAG (COG – land use) / MTC (MPO – transport)	SCAG
RTP or Blueprint Performance Metrics	RTP/Blueprint: targets for transit use, VMT, GHG, congestion, balanced funding, bike/ped trips, housing variety	RCP: targets for density, LU, transit use RTP: mobility, reliability, system preservation/ safety, healthy environment, prosperous economy, social equity	RTP: targets for 3 E's- Economy: travel delay/ capita, maintenance, collisions/fatalities, emergency preparedness, security Environment: reduce VMT/ capita by 10% Equity: decrease HH expenditure on housing by 10%	Compass: transit use, VMT, travel delay, GHG, air quality RTP: emissions, mobility, environmental justice, accessibility, reliability, productivity, safety, sustainability, preservation, environmental, and cost-effectiveness
RTP Findings	Investments balanced between transit, roadways, and bike/ped facilities. Transit investments: light rail/streetcar extensions and improvements, over 10 BRT lines, and expanded express/ local bus services. Roadway investments include new HOV lanes and two regional expressways; VMT/HH declines from 2005 baseline	Reduce GHG emission and improve air quality through Sustainable Communities Strategy or Alternative Planning Strategy (if needed)	Land use and pricing mechanisms needed to meet performance targets – infrastructure alone could not achieve Sets specific targets (percent reductions/ absolute numbers) for reduced collisions/ fatalities, GHG and criteria emissions, and housing affordability	Focus on maintaining already existing infrastructure and infill. Increase HOV and vanpool lanes and capabilities, encourage telecommuting, increase bicycle infrastructure, toll roads, also, focus on the HSR being implemented.
BLUEPRINT: Horizon Year Jobs/ Household	2035 Regional Growth Forecast projects higher transit ridership and reduced roadway congestion due to concentrating development along transit corridors. Further, it estimates a 10 percent reduction in congestion for every 1 percent shift from auto to transit	SGCM and RCP accommodate 40% of smart growth areas as existing or planned (per General Plans), while 60% are potential growth areas	FOCUS PDAs will accommodate 50% of housing growth in moderate densities	Decline in VMT and travel delay; increase in transit use
Base Year Jobs/ Household	1.08 (2006)	1.17 (2006)	1.22 (2006)	1.20 (2006)
Horizon Year Jobs/ Household	1.15 (2035)	1.38 (2030)	1.59 (2035)	1.33 (2035)
Includes Planned or Programmed Interregional Highway Routes?	$2.9 billion for state highway improvements, mainly to complete four-lane highways to connect the northern counties with the rest of the region, and to add carpool lanes to urban freeways Planned interregional highway investment: $934.569 mill.	Planned Expenditures: $595 million (minimal interregional highway coverage in region)	Planned Expenditures: $3.307 billion Programmed/Committed Expenditures: $2.525 billion	Planned Expenditures: $2.498 billion
Includes Planned or Programmed Interregional Rail corridors?	No interregional rail investment	Planned Expenditures: $4.460 billion	Planned Expenditures: $8.772 billion Programmed/Committed Expenditures: $8.533 billion	Planned Expenditures: $3.924 billion (total transit: $44b + $29b for HS Regional Rail)
Includes Planned or Programmed Goods Movement System?	Goods Movement Action Plan is part of RTP. Truck corridors identified, commercial truck VMT declines by 2% and congested travel declines 36%	Planned Expenditures: $933 million	No goods movement discussion	*Total* Planned Expenditures: $36.4 billion

San Joaquin Valley								
RTP	**Fresno COG**	**Kern COG**	**San Joaquin COG**	**Stanislaus COG**	**Tulare County Association of Govts**	**Merced County Association of Govts**	**Kings County Association of Govts**	**Madera County Transp Commission**
RTP Base Year	For all: 2006							
RTP Horizon Year	For all: 2030							
RTP Budget	$4.7 billion	$3.9 billion	$10 billion	$3.6 billion	$4.7 billion	$1.17 billion	--	$1.15 billion
Expected / Adopted	2007	2007	2007	2007	2007	2007	2007	2007
Blueprint Visioning Done Prior to RTP	For all: San Joaquin Valley Blueprint 2050 (2009)							
Blueprint Visioning Details	All are UPlan-Based; included Trend Scenario (4.3du/acre), Locally Selected (5.9du/acre), Valley-Wide Hybrid (10du/acre)							
RTP Scenarios	2030 No Build 2030 RTP Plan	2030 No Build 2030 Build	Transit Emphasis; Highway Emphasis; No Build; RTP Alternative	Baseline/ Existing Network; Baseline/No Build; 2030 Plan; Unconstrained	2030 No Build 2030 RTP Plan	No Build; Roads; Some Changes; More Changes; Alternative Modes; Alternative Modes and Roads	2030 No Build 2030 RTP Plan	2030 No Build 2030 RTP Plan
Adopted RTP Scenario	2030 RTP Plan	2030 Build	RTP Alternative	2030 Plan	2030 RTP Plan	More Changes	2030 RTP Plan	2030 RTP Plan
Regional Land Use Allocation Projections	All based on 2030 Department of Finance Projections							
What Extent is Adopted RTP Based on Blueprint Land Use?	For all: Current RTP is not, but upcoming 2011 RTP will use land use information							
Base Year Jobs/ Household	1.17 (2006)	1.05 (2006)	1.02 (2006)	1.0 (2006)	1.11 (2006)	.87 (2006)	1.06 (2006)	.97 (2006)